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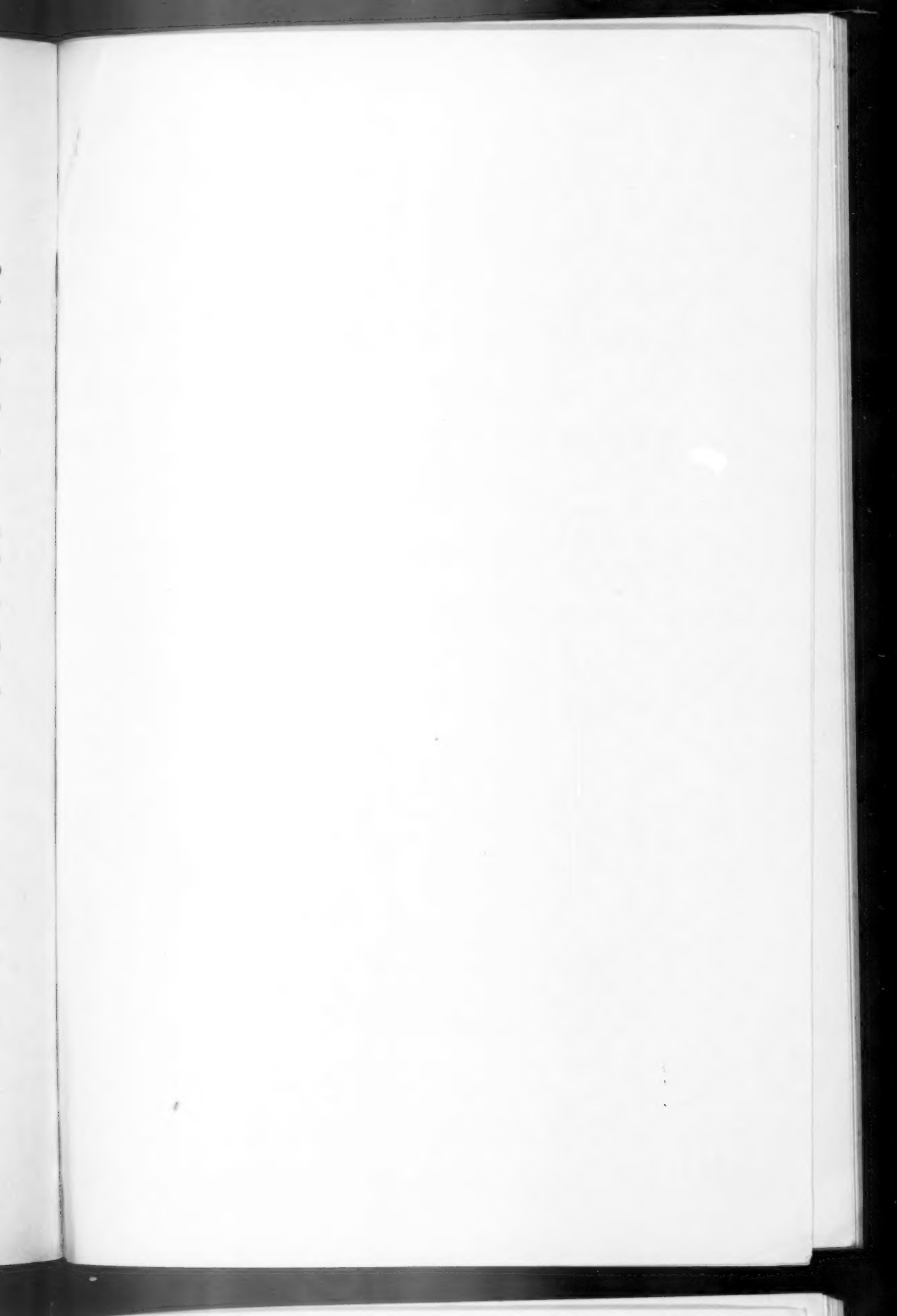
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(Upper, left) CLUMP OF MISTLETOE SEEDS COLLECTED UNDER A PERCH OF THE PHAINOPEPLA. (Upper, right) TYPICAL DESERT-WASH HABITAT; PHAINOPEPLA IN TOP OF TREE. (Lower) TYPICAL DESERT HABITAT OF THE PHAINOPEPLA. PHOTOGRAPHS TAKEN IN SAN DIEGO COUNTY, CALIFORNIA.

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DISTRIBUTION AND HABITAT RELATIONSHIPS OF THE PHAINOPEPLA

BY JAMES E. CROUCH

Plates 8, 9, 10

ONE of the most characteristic birds of the southwestern United States is the Phainopepla, *Phainopepla nitens lepida* Van Tyne. On the deserts it frequents the mesquite and mistletoe. In the foothills it is seen among the live oaks, sycamores and sumachs. Everywhere it gives evidence of having a very erratic nature. The purpose of this paper is to attempt to define more clearly the boundaries of the range of the Phainopepla, to present some data as to its abundance in the various parts of its range and finally, as a result of a study of the habitat, to indicate some of the factors influencing its distribution. The literature has been carefully studied and considerable field work was carried out in southern California and in the Yuma region of Arizona.

The distribution maps (Text-figures 1 and 2) were made up from published records of the occurrence of the Phainopepla. They show at a glance the extent of the range, and closer examination reveals other important factors concerning distribution and abundance.

The Phainopepla has been found as far north as Shasta County, California (Townsend, 1887):

I am almost certain that I saw this species at Baird late in June, 1883. Its claim to being a bird of the region is established by the fact of its having been taken at Fort Crook by Captain Feilner. This is probably the most northerly record of its range.

The records in this area are scarce but those that we do have seem to be well founded. Farther south, records are more numerous along the foothills of the Sierras and the coast range. The occurrence of the species in western Nevada and southwestern Utah is indicated, but actual records are scarce. In southern Arizona the species is



TEXT-FIGURE 1.—Distribution of *Phainopepla nitens lepida* Van Tyne. Each dot represents a published record of occurrence.

common as indicated by many records and the appearance of many Arizona birds in museum collections. There are a few records for southwestern New Mexico and western Texas.

No effort has been made to indicate the range of the species in the Republic of Mexico except in the state of Lower California. The reason for this is that the ranges of the subspecies *lepida* and *nitens* come together or likely overlap in this area and until sufficient material is available for careful examination there is no means of differentiating them. Before the species was divided into the two subspecies, Salvin and Godman (1879–1904) wrote that it occurs throughout central and northern Mexico. They said it was absent from the western coast and probably did not occur much to the southward of Mexico City. In Lower California it is found throughout, except on the higher mountains.

The differences between summer and winter ranges will be discussed along with the detailed accounts of distribution and abundance

within the individual states of the range. In general it can be said that in winter the numbers of birds in the coastal regions and in the more northern parts of the range are reduced while on the deserts they are increased.



TEXT-FIGURE 2.—Distribution of *Phainopepla* in California. Published records indicated by dots.

CALIFORNIA.—The map of California (Text-figure 2) shows the distribution of the *Phainopepla* in this state. It does not, however, show anything of the abundance of the birds in the various areas. It can readily be seen that the *Phainopeplas* prefer the desert and foothill regions. They are found near the coast from San Diego to Marin County. From Marin County north there are no coast records though they are found inland as far north as Shasta County. Two records are available for Santa Catalina Island, one by Wyman (1919) of a flock seen May 14, 1919, and one by Bryant (1918) on June 12, 1918.

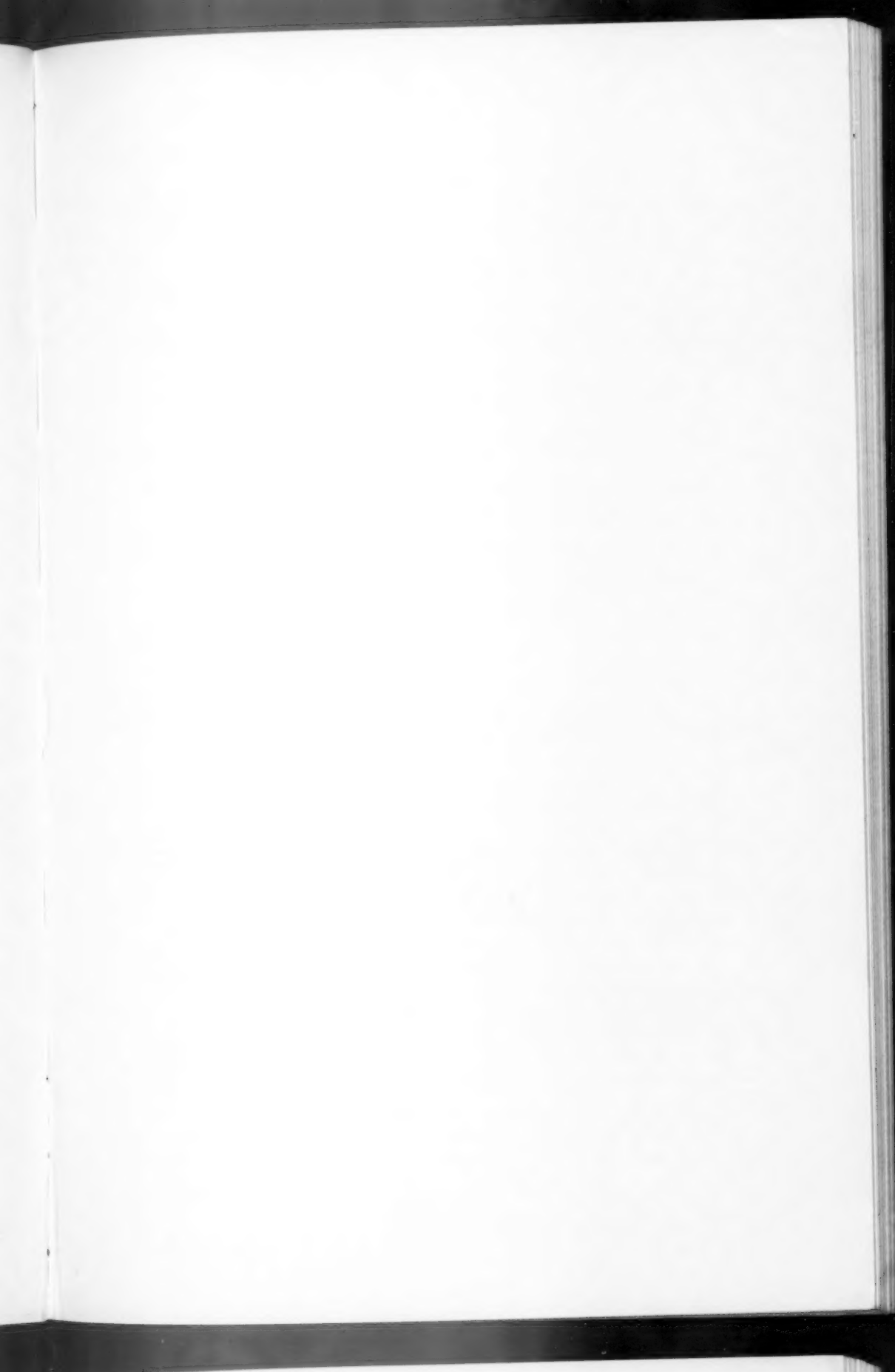
Studies of the records and observations of the writer indicate that the *Phainopeplas* are quite common year-around residents on the deserts of southeastern California though they are probably less common in the summer. In the foothill regions from San Diego

County north to Marin County (Mailliard, 1900) they are common summer visitants locally. They are found also along the western foothills of the Sierras through Eldorado to Shasta County and east of the Sierras into Owens and Panamint valleys (Grinnell, 1915). In the winter they are scarce in the San Diego region. For the past nineteen years the San Diego Museum of Natural History has been conducting bird censuses in the vicinity of San Diego and their records show that the *Phainopeplas* were seen as follows: 1930-1933, two each year; 1933-1934, one each year; 1935, five; 1936, one; 1937, six; and 1940, six. In the other years none were seen. Gardner (1914) reports that while the *Phainopeplas* are known to winter in the Claremont (California) region in small numbers, they were common one winter, at least one bird being seen each day. Only one winter record for northern California has been found and this was reported by Muller (1915) for Marysville, in Yuba County. It was a verified record as the bird, a female, was collected.

Although the *Phainopepla* is usually found at relatively low altitudes, two records are at hand which indicate that it sometimes wanders well up into the mountains. Stevenson (1933) reports seeing one at Mount Pinos, California, on June 12, 1932, a male, flying high among the yellow pines. The elevation was given at 6,200 feet and the bird was considered to be a straggler from the Mohave desert via Cuddy Valley. Hoffman (1933) observed one, a female, at Barley Flats, San Gabriel Mountains, California, on December 30, 1932. The elevation at Barley Flats is 5,500 feet and at the time of the observation there was one foot of snow on the ground. These records should be considered unusual, but they do emphasize the erratic nature of these birds.

Breeding occurs in both the Upper and Lower Sonoran life zones, more commonly in the latter. A number of records are available to indicate that both male and female birds are present during the spring and summer as far north as Sutter County (Follett, 1933). While no actual breeding records have been made there, it seems likely that nesting might take place. The same set of circumstances prevails in Calaveras County where the birds are reported to arrive in the spring, stay through the summer, and leave in the fall (Belding, 1879). In Solano County there are established breeding records (Grinnell, 1927), and breeding seems to be of regular occurrence in favorable areas from this region southward.

In the Lower Sonoran desert regions breeding occurs wherever nesting sites and sufficient food are available. Records are at hand





(Above) WILLOW-SYCAMORE ASSOCIATION IN ALVARADO CANYON, SAN DIEGO COUNTY, CALIFORNIA. (Below) LIVE OAKS IN WHICH PHAINOPEPLAS NESTED; SAN DIEGO COUNTY.

for Coachella, Riverside County (Clary), Twenty-nine Palms, San Bernardino County (Carter, 1937), Mecca, Riverside County (van Rossem, 1911), and the Lower Colorado River Valley (Grinnell, 1914). In addition, the author has studied a number of nesting pairs in eastern San Diego County.

The following records serve to describe further and to verify the material presented above concerning the distribution of the *Phainopepla*. Pemberton (1908) writes as follows:

Phainopepla nitens has been recorded along the foothills of the Sierras at various places north as far as Marysville, but previous to my observations the northern limit in the Coast Range was Mt. Hamilton where R. H. Beck noted one bird in November, 1899, and Ernest Adams also recorded a bird from near the same place on October 28, 1898. Joseph Mailliard reports having heard their note in Marin County, but has never seen a bird.

On June 23, 1907, while in the Arroyo Mocho in Southern Alameda County, I saw six of these birds which I took to be a family of four young and their parents. On April 1, 1908, near the same place I again saw a pair of *Phainopeplas*, but failed to secure either bird. Later in the year, however, while doing extended geological work in Arroyo Mocho I again met with the birds several times, and I believed several pairs to have raised broods this last summer.

Grinnell and Storer (1924) recorded the *Phainopepla* as resident in small numbers in the Upper Sonoran at the west base of the Sierras where it frequents the blue-oak belt, staying about clumps of mistletoe and other berry-producing plants. They found it at Pleasant Valley in May and November, 1915, and near Coulterville in August, 1920. No nests were recorded at Pleasant Valley. In a study of the Lassen Peak region, Grinnell, Dixon, and Linsdale (1930) mention a record of a single bird seen by W. P. Taylor on June 8, 1912, at Mill Creek.

NEVADA.—The occurrence of the *Phainopepla* in the desert regions of southern and western Nevada is certain. An early record of its presence is that of Ridgway (1877) who stated that he heard it on several occasions among the cedar and piñon woods of the desert ranges in western Nevada and saw it in the Soda Lakes region of the Carson Desert. Cottam (1936) writes as follows:

Linsdale writes that the northern limit of the *Phainopepla* (*P. nitens lepida*) in the state is not known. It may be reported that these birds frequented a small wild plum thicket in the town of Alamo each summer from May to September.

This last record would make nesting seem likely at Alamo. Coues (1878) states that it was secured by Mr. Ferdinand Bischoff in southern Nevada. Van Rossem (1936) makes the following observations in the region of the Charleston Mountains:

Phainopepla nitens lepida Van Tyne. *Phainopepla*. On July 19, 1932, a male phainopepla in parti-colored (one year old) plumage was collected in a pinon-juniper stand at Cold Creek. This individual was not breeding and we considered it to be a vagrant. Two adult males were seen in mistletoe-covered mesquites at Indian Springs on September 13, 1930. Fisher (1893) records the phainopepla as noted by Merriam at Mountain Springs on April 13, 1891.

We failed to find any evidence that the region is inhabited by breeding phainopeplas, or even that the species occurs in any numbers during migration; the few records are most probably those of vagrants.

UTAH.—The *Phainopepla* has been reported on several occasions from southern Utah and is apparently a breeding bird. Tanner (1927) records it from the Virgin River Valley and St. George. He records that it is a common summer visitant, breeding in May and part of June. Fisher (1891) reports it from the Santa Clara Valley between June 11 and 15, and states that several pairs were breeding at St. George. It is doubtful if the birds go far beyond this southwestern portion of the state and it seems safe to assume that they are found there only during the summer.

NEW MEXICO.—Bailey (1928) gives a very clear picture of the distribution of the *Phainopepla* in New Mexico and it is quoted here in its entirety:

State Records.—The southwestern part of New Mexico is the home of the small numbers of the *Phainopepla* that occur in the State, and here it is mostly rare and local. Doctor Henry says that in 1853 it arrived at Fort Webster on May 25, and nested on the Mimbres, but he saw none after July. It ranges commonly up the Rio Grande to Palomas Hot Springs and Elephant Butte. Fresh eggs were found at Elephant Butte, May 25, 1926 (Ligon, 1916–1918). Other records are those of one collected July 28, 1892, at Big Springs, Guadalupe Canyon, in extreme southwestern Grant County (Mearns); one seen August 17, 1908, at Silver City (Birdseye); one collected October 6, 1908, at Gila, 4,700 feet (Goldman); and one taken October 20, 1912, 20 miles east of Silver City (Kellogg).—W. W. Cooke.

It is evident from the above that the *Phainopepla* is by no means a common bird of New Mexico. The records which are available show that it is a breeding bird in the state, but the writer knows of no winter records. The few records mentioned are indicated on the map (Text-figure 1).

TEXAS.—Little can be said for the *Phainopepla* in Texas. Most authors state that its range extends into the west-central part of the state, but only one record has come to the writer's attention to indicate this. Coues (1878) reports that Mr. H. E. Dresser procured specimens at Eagle Pass, Texas.

ARIZONA.—Examination of the map (Text-figure 1) will show that the *Phainopeplas* are quite generally distributed through southern

and western Arizona. Swarth (1914) states that they are common summer visitants in the Lower Sonoran of southern and western Arizona and are reported from many points as far north as Fort Apache, Fort Whipple, and Fort Mohave. They remain locally throughout the winter in southern Arizona and along the Colorado River.

Three other references serve further to validate the distribution as given above. Coues (1866) wrote of the *Phainopepla*:

Summer resident, rather uncommon in the immediate vicinity of Fort Whipple. A little further south, however, it is found very abundantly, and is doubtless a permanent resident in the southern portions of the territory. It inhabits rather open country, in preference to densely wooded regions.

Scott (1888) has met with these birds at every point up to 5,000 feet in Pinal, Pima, and Gila Counties. He states that they are migratory except at Tucson and in the region to the southward and here only winter in small numbers. He believes they breed throughout their range. In the Catalinas they have been observed at 4,000 feet elevation and the earliest spring record is April 25.

The following records are from Swarth (1920) on the *Birds of Papago Saguaro National Monument and Neighboring Region of Arizona*:

Papago Saguaro Monument—Seen May 30 to June 4, 1917.

Tempe and surrounding farm lands—Seen May 30 to June 4, 1917.

Vicinity of Roosevelt Lake—June 5 to 11, and July 2 to 5, 1917.

Globe—July 5 to 7, 1917.

LOWER CALIFORNIA.—Grinnell (1928) summed up the distribution of the *Phainopepla* in Lower California as follows:

Varyingly common throughout the territory save on the higher mountains; permanently resident wherever found except that it is a scarce species in winter on the Pacific slope north to latitude 30°. Breeding lifezone, Lower Sonoran, locally Upper Sonoran; prefers the mesquite association wherever this is to be found. First reported by Baird (1859, p. 303, under name, *Phainopepla nitens*) as taken by Xantus at [San Nicolás near] Cape San Lucas [October 10, 1859] (see Baird, 1866, p. 416). There is no known island record for this bird. Published records from the mainland localities are so numerous that only a few are here given.

Grinnell includes a list of seven records and lists the localities represented by specimens in the Museum of Vertebrate Zoology, Berkeley, California. Bancroft (1930) states that these birds are plentiful in Jose Maria Canyon and progressively less so as one travels to the east. He found them absent locally from altitudes of over a thousand feet. Brewster (1902) found them resident in the Cape Region and

apparently about equally common at all seasons. He says that Anthony met with them from Ensenada southward, up to an altitude of 6,000 feet usually in mesquite thickets.

A number of interesting facts have been evident through this state-by-state discussion of the distribution of the Phainopepla. They are as follows:

1. Phainopeplas are generally resident in the Lower Sonoran regions of the deserts though their numbers are somewhat reduced in these areas farther north in the winter.

2. They nest quite commonly in the Upper Sonoran regions but are generally scarce or absent from such areas during the winter.

3. They are not found, except in rare cases, in the mountains, though they may be common in the foothills.

4. The records for northern and central California are mostly from the Upper Sonoran life zone and are of summer birds.

5. The records indicate in many cases a grouping or local abundance of the birds, with large areas in which no records were made, although there are ornithological reports from many such areas. Anyone who has studied these birds would expect just such a condition, as the birds seem to be limited by quite definite factors which will now be considered.

HABITAT RELATIONSHIPS.—The most important factor in the environment of the Phainopeplas is vegetation for it furnishes them with food, shelter, and a place to raise their young. Of all the plants the mistletoe (*Phoradendron*) is the most important, and on the desert the quickest way to find Phainopeplas is to first find mistletoe which grows so abundantly there on the mesquite (*Prosopis*) and ironwood (*Olneya*) trees. No less than fifteen references are available which make special note of this association. The Phainopeplas help in the distribution of the mistletoe for they eat the berries and the seeds pass through the digestive tract and cling to the branches below, where they germinate. Plate 8 (upper left) shows a whole clump of these seeds which accumulated under the perch of a Phainopepla. Such clumps are of common occurrence in the desert regions, especially during the winter when the birds do little but gorge themselves with mistletoe berries and then go to some favorite perch to digest them. These clumps can be seen at some distance and are indicative of an extended residence of the Phainopeplas. The fact that the birds so often use dead branches helps to save the trees from an overabundance of the mistletoe, for these branches break off, taking the seeds with them. If they do not break off they at

least give little to support growth of the mistletoe. The upper right and lower figures of Plate 8 illustrate the typical desert situations.

Grinnell (1914) in studying the birds of the Colorado Valley from Needles, California, to Yuma, Arizona, says that the Phainopeplas were closely restricted to two narrow belts along the river, one on each side, constituting the mesquite association. He says that the coincidence of the range of the bird with this association was "clearly due solely to the preferred food afforded in constant and abundant quantity by the berries of the mistletoe parasitic upon the mesquite." He believes that they would have availed themselves "of edible berries in whatever part of the region these might have been produced."

West of the mountains, quite a different association of plants is frequented by the Phainopeplas. No one plant is as influential as the mistletoe of the deserts. The willow (*Salix*), sycamore (*Platanus*), and live oak (*Quercus*) associations seem to be favored. Most of the observations made in western San Diego County have been in such areas (Plate 9). Often the birds were found in small side canyons in which scrub oaks (*Quercus*) and sumachs (*Rhus*) were found. For food in these areas the Phainopepla depended largely on elderberry (*Sambucus*), red-berry (*Rhamnus*), and pepper berries (*Schinus*). The birds are seldom found on open mesas, always showing a definite preference for canyons (Plate 10, upper figure).

Mistletoe occurring west of the mountains also attracts Phainopeplas but it does not serve as a limiting factor as it does on the desert. Grinnell and Storer (1924) found them in small numbers at the west base of the Sierra Nevada where they frequented the blue oak belt, staying about clumps of mistletoe and other berry-producing plants.

The Phainopeplas seem to have adapted themselves to changing conditions brought about by man. In many of the agricultural areas they have become quite common, nesting in orange groves and apricot orchards. Plate 10 (lower figure) shows a nest in an apricot tree at Lakeside, California. Woods (1932) in the *Condor* says:

Phainopeplas nest abundantly in the orange groves and orchards but are not attracted by fruit except berries, particularly those of the native buckthorn (*Rhamnus crocea*). They are however exceedingly addicted to the fleshy, sweetish petals of the Feijoa sellowiana or Paraguay Guava. These shrubs bloom profusely in early summer and companies of Phainopeplas constantly congregate about them.

More evidence of their tolerance of man is indicated by Bailey's (1922) report that they came to get water at a feeding station, several at a time. This record is of special interest as the writer has found

no reference of their coming to water other than this one, and has seen them bathe only once in the wild. This observation was made at Lakeside, California in the spring of 1940. They are most often found near water, probably because of the greater abundance of food to be found there. They also occur far away from water and hence must be capable of getting enough moisture from berries which they eat.

The relationship of the Phainopeplas to other animals is, for the most part, a friendly one. During the breeding season there is the usual evidence of competition for nesting sites, but this is far more keen among individual Phainopeplas than between them and other species. Of all birds the Western Mockingbird (*Mimus polyglottos leucopterus*) gives the most trouble throughout the year. Dawson (1923) says:

The Western Mockingbird not only plagiarizes the Phainopepla's notes most outrageously, but it seems to take a special delight in persecuting these timorous little mortals. Once in winter, I heard the round perp-note of a Phainopepla sounding from a clump of mistletoe, in a tall Cottonwood at Potholes. He had scarcely uttered his note three times when he was set upon and ousted by some enemy which I could not plainly see. Suspecting a Sharp-shin, I raised my gun and fired at the first show of form. I had intended to lay out the miscreant with a charge of 8's; but the wrong hammer struck, and from out the harmless shower of "dust" emerged a well-rebuked Mockingbird.

The following lists of common bird-associates of the Phainopepla were taken directly from my field notes:

Mission Gorge, San Diego County, May 5, 1935:

Bush-tit (*Psaltirparus minimus*)
 Wren-tit (*Chamaea fasciata*)
 Lazuli Bunting (*Passerina amoena*)
 Western Lark Sparrow (*Chondestes grammacus strigatus*)
 Cedar Waxwing (*Bombycilla cedrorum*)
 Western Mockingbird (*Mimus polyglottos leucopterus*)
 Arizona Hooded Oriole (*Icterus cucullatus nelsoni*)
 Common House Finch (*Carpodacus mexicanus frontalis*)
 Western Meadowlark (*Sturnella neglecta*)
 California Towhee (*Pipilo fuscus crissalis*)
 Green-backed Goldfinch (*Spinus psaltria hesperophilus*)
 Brewer's Blackbird (*Euphagus cyanocephalus*)
 Northern Cliff Swallow (*Petrochelidon albifrons albifrons*)

Yaqui Wells, San Diego County, February 19, 1938:

Western Mockingbird (*Mimus polyglottos leucopterus*)
 Northern Cactus Wren (*Heleodytes brunneicapillus couesi*)
 Gambel's Sparrow (*Zonotrichia leucophrys gambeli*)
 Gnatcatcher (*Poliopitila species*)
 Arizona Verdin (*Auriparus flaviceps flaviceps*)

Yaqui Wells, San Diego County, April 2, 1938:

- Common House Finch (*Carpodacus mexicanus frontalis*)
- Plumbeous Gnatcatcher (*Poliophtila melanura melanura*)
- Arizona Verdin (*Auriparus flaviceps flaviceps*)
- Costa's Hummingbird (*Calypte costae*)
- Black Phoebe (*Sayornis n. nigricans*)
- Gambel's Sparrow (*Zonotrichia leucophrys gambeli*)
- Western Chipping Sparrow (*Spizella passerina arizonae*)

Mason Valley, San Diego County, April 15, 1938:

- Western Flycatcher (*Empidonax d. difficilis*)
- Western Mockingbird (*Mimus polyglottos leucopterus*)
- Valley Quail (*Lophortyx californica vallicola*)
- Gambel's Sparrow (*Zonotrichia leucophrys gambeli*)
- Black-throated Gray Warbler (*Dendroica nigrescens*)
- Bullock's Oriole (*Icterus bullocki*)
- Costa's Hummingbird (*Calypte costae*)
- Arizona Verdin (*Auriparus f. flaviceps*)
- Northern Cliff Swallow (*Petrochelidon a. albifrons*)
- Golden Pileolated Warbler (*Wilsonia pusilla chryseola*)
- Road-runner (*Geococcyx californianus*)
- California Towhee (*Pipilo fuscus crissalis*)
- Barn Swallow (*Hirundo erythrogaster*)
- California Thrasher (*Toxostoma r. redivivum*)

Alvarado Canyon, San Diego County, April 30, 1938:

- Western Mockingbird (*Mimus polyglottos leucopterus*)
- Dwarf Cowbird (*Molothrus ater obscurus*)
- Golden Pileolated Warbler (*Wilsonia pusilla chryseola*)
- Calaveras Warbler (*Vermivora ruficapilla ridgwayi*)
- Hutton's Vireo (*Vireo h. huttoni*)
- San Diego Wren (*Thryomanes bewicki correctus*)
- Black-headed Grosbeak (*Hedymeles m. melanocephalus*)
- Western Flycatcher (*Empidonax d. difficilis*)
- Bullock's Oriole (*Icterus bullocki*)
- Western Tanager (*Piranga ludoviciana*)
- Western Meadowlark (*Sturnella neglecta*)
- Western Wood Pewee (*Myiochanes r. richardsoni*)
- Coast Bush-tit (*Psaltiriparus m. minimus*)
- California Towhee (*Pipilo fuscus crissalis*)
- Tule Yellowthroat (*Geothlypis trichas scirpicola*)
- San Diego Towhee (*Pipilo maculatus megalonyx*)
- Green-backed Goldfinch (*Spinus psaltria hesperophilus*)

These birds occupy the same general areas as the *Phainopepla*, many feed upon the same type of food, and nest in the same bushes and trees, but, except for the Mockingbird, little friction is evident among them. The fact, however, that they do all occupy the same area is undoubtedly a factor in limiting the number of *Phainopeplas*.

The Dwarf Cowbird should be listed as one of the enemies of the Phainopeplas for it is known to lay eggs in their nests, leaving them to be hatched and the young to be cared for by the Phainopepla. Friedmann (1931) says:

Rowley (*Condor*, 1930, pp. 130-131) found a nest of this bird containing a young Dwarf Cowbird as well as a young Phainopepla. This is the second record for this bird as moicethrine host.

Migration. The migration of the Phainopepla is a problem which will take many years to solve. Before any answer can be found, hundreds of birds in all parts of the range must be captured, banded, released, and then recaptured. While banding activities have been carried out by the Biological Survey of the United States Government for many years, no Phainopeplas have been banded. The greatest obstacle in the way of such a study would be the capture of birds in Mexico where there are few, if any, banding coöperators. Also the vast, uninhabited regions in Mexico would be hard to work.

Regardless of all these problems, certain rather definite conclusions can be drawn concerning the migration of the Phainopeplas. In the author's field notes there are spring-arrival records for April 21, 1934; April 15, 1935; May 3, 1936; and April 30, 1938—all seen in San Diego, California. Similarly it has been found that they begin to disappear from San Diego in August and are not common thereafter until the next spring. On October 4, 1936, they were recorded in East San Diego. Like records have been presented in the previous discussion for other parts of the state west of the mountains. All of these records point to a northward migration in the spring and a southward migration in the fall. This migration seems to be complicated by a movement of birds from the deserts of southeastern California presumably into the cooler climates to the north and west. This exodus of the birds from the desert, when it occurs, follows the breeding season along in late April or May. All individuals do not leave and in some areas apparently none. Dawson (1923) says of this migration:

The desert-wintering birds remain to breed in late February, and in March; and then in April migrate to the cooler sections of the state, west and north. Whether these desert-nesting birds breed again when they arrive at their summer home, we do not know; but it is more probable that they remain as a non-breeding element in the local summer population. The bulk of the birds coming from directions and places unknown, irregularly invade the western portions of southern and central California about the middle of April, with fresh accession of numbers up to June 1st. They abound in the San Fernando and neighboring Valleys, clinging, rather fatuously, to the dwindling desert washes, although they appear to be relatively less common in San Diego County.



(Above) PHAINOPEPLAS FREQUENT THE SUMACHS ON THE CANYON SIDES; MISSION GORGE, SAN DIEGO COUNTY, CALIFORNIA. (Below) FEMALE PHAINOPEPLA NEAR NEST IN APRICOT TREE; LAKESIDE, SAN DIEGO COUNTY.

After noting the disappearance of the birds from the desert in the spring of 1938 without breeding, it occurred to the author that possibly these were the ones which came into the foothills, north and west. In San Diego County my experience has shown that the *Phainopeplas* which come west of the mountains do nest, at least the majority of them do. It is not logical to suppose that they would nest on the desert, migrate, and again nest as Dawson (1923) suggests. Perhaps each year there are some birds which fail to nest on the deserts either to the south or east and they are the ones which come into areas such as San Diego.

The migration in the late summer and fall is as evident as that in the spring, and the problem is somewhat the same. Do the birds move only to the south or do they move across the mountains to the east? An increase in the number of desert individuals would indicate the latter. Records which have been presented in the discussion of distribution make it sound plausible that the birds may cross the mountains. Birds occurring in the Los Angeles area and to the northward, up the coast through San Luis Obispo, Salinas, and San Jose, could easily move to the Colorado Desert by way of San Bernardino, Beaumont, and Banning without going over any high mountains. In San Diego County the author has seen birds at Warner's Hot Springs which is the highest point they would need to reach in travelling from San Felipe, Borego, or Mason valleys to the foothills west of the mountains. Such migrations could be made over the mountains without leaving the Upper and Lower Sonoran life zones. Therefore, as far as topography is concerned, there is no good reason why *Phainopeplas* should not move from one side of the mountains to the other. Only banding, of course, can prove this beyond a doubt.

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BREEDING NOTES ON THE PHAINOPEPLA¹

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IN Mrs. Bailey's ('Birds of New Mexico,' p. 595, 1928) sketch of the breeding habits of *Phainopepla nitens*, she comments on the variety of its notes, and implies that its melodious song is a conspicuous feature of the bird. She goes on to say that the male often assumes the duties of the female, building the nest and brooding the eggs, while the female flies about with her sisters awaiting the time to care for their young.

Crouch (Abstracts of Dissertations, University Chronicles Series, University of Southern California Press, Los Angeles, 1939), in a summary of his work on the *Phainopepla* in California, says that the song of the male is somewhat subdued and is heard chiefly during the establishment of territory, acquisition of a mate, and nest building.

¹ Contribution from the Archbold Expeditions of the American Museum of Natural History, New York City.

He also says that the male may start several false or 'dummy' nests and that these are torn down and used in the construction of the real nest, built largely by the male. Later he says that male and female share the duties of incubation but that after the young hatch the male shows less interest in the nest.

Our observations on this species, made during the course of other work, near Tucson, Arizona, during the period February to June, 1940, indicated a somewhat different pattern of behavior than that presented in these two somewhat contradictory accounts. Part of these differences may perhaps be due to geographical variation in habits.

Some *Phainopeplas* apparently spend the winter in the Tucson area (Swarth, *Pacific Coast Avifauna*, no. 10: 64, 1914). The first we saw, shortly after our arrival, was a male on February 8; the next record was of a party of four males and two females on February 12. By February 16, the birds were fairly common, and ten or twelve days later the males appeared to have established territories. About March 12, there was another influx of birds into the area, and twelve days or so later these, too, had spread out over the country and occupied territories.

The first nest was found in construction on February 27, the first egg was laid in it on March 3; nests in construction were found through March, April and May, with concentration about the first part and the end of March. The last occupied nest seen was one which the young birds left on June 12. Perhaps some of the later nests were second nests. By the latter part of May, bands of adult and young birds were moving about over the country. Male birds appeared to predominate greatly until late May, when the young birds, resembling females, appeared. Some observations recorded below indicate that the females are more retiring than the males and the discrepancy in the sex ratio may be more apparent than real.

The cottonwood groves along the washes, and the mesquite thickets were favorite habitats, the former being preferred. Here the *Phainopepla's* favorite food, mistletoe berries, occurred in abundance, and here they nested. The nests in mesquite and cottonwood, varying from five to fifty feet above the ground, were typical structures (see Crouch, 1939).

Most of the following observations were made at about fifteen territories; casual observations were made at a number more.

As Crouch has recorded, the *Phainopepla* establishes a territory. It may be small, as some nests were no more than 25 yards apart.

The *Phainopepla* gets much food outside of its territory, even when there is abundant food within it. Our observations indicate that the male advertises himself by making himself conspicuous to the eye rather than by singing. From birds that quickly secured mates we heard no singing, and it was only from males that for some weeks had failed to secure mates that we heard the rather forced, deliberately phrased song, and then only occasionally. The unmated males spent much time on conspicuous perches in their territories, frequently flying sharply upward, swinging about, and flying back to their perches, displaying their white wing-patches, which contrast with their black plumage. Some of these flights may have been to catch insects, as they have been frequently interpreted, and sometimes these birds do take insects on the wing, but most of the flights at this time appeared to be for display.

Females flying over an occupied territory were frequently pursued by the male. Crouch intimates that the male is defending his territory against these females. It seemed to us that the male, on these occasions, was attempting to induce the female to take part in a courtship flight. Sometimes the female joined the male in such a courtship flight; together they rose sharply, the male following the female, in a pattern of circles over the territory which lasted for a half-minute or more. There was no quality of actual hurried chase; it looked more like an aerial dance. These display flights were continued between mated pairs until incubation started, but the female did not necessarily accept the male or the territory after having joined the male in such a flight. At one territory the female flew directly away after such a flight, and though the male stayed in the vicinity for the rest of the day and even worked at a nest there, this territory was abandoned.

The males started nest building before they secured mates. Frequently a building male made high circular flights to the nest with material, apparently to advertise himself. On several occasions we saw a female follow such a building male to his nest. On one occasion the female was driven away from the nest by another female, presumably the male's mate.

A male often made rapid trips to the nest while without a mate; one such male made thirty trips in an hour and could have made more, for the material he was using, the silk of tent caterpillars, was abundant and close at hand, and the male frequently paused and sat quietly for a few moments nearby. Sometimes a male made circular flights out from the nest. The amount of material carried each

time by building birds was usually very small, often only a few strands of tent-caterpillar silk, and it was usually difficult to be sure they were carrying anything. Sometimes a female was in the territory unobserved until the male flew to her. Once we saw a male, building alone, fly to a female we had not observed, and apparently offer her the building material he had in his bill. She opened her bill and quivered her wings; the male then carried the material to the nest. The female paid him no further attention and shortly flew away. One other time we saw a male, building alone, interrupt his building to fly to a female which we had not observed perched low in dense shrubbery, and feed her by regurgitation. The female took no interest in the subsequent nest building of the male and soon left. This male definitely remained unmated for some weeks.

When a female joined a male on his territory, there were sometimes many flights in which both took part; sometimes there were few. The nest was built chiefly by the male, but the female aided in its completion. Sometimes she made trips independent of the male; sometimes he flew to the nest from a nearby perch as she came to it. Once, at least, we saw a female carry material to the nest. At one nest, between 9:20 and 10:20 A. M., the day before the first egg was laid, the male made ten trips to the nest, sometimes with material we could see, and each trip he sat in the nest, moulding it and working at the rim. During this time the female made but one trip to the nest; whether or not she carried material we could not see, but she sat on the nest, moulding it and working at it with her bill.

Sometimes during this period the male flew to the female, which was sitting quietly on a conspicuous perch, and fed her berries by regurgitation. Once a male fed a female in such a situation three berries in succession, the female holding her mouth open for the last two, but not quivering her wings; both birds were silent and then sat quietly. Another time, two days before the first egg was laid by the female of a pair, the male flew to her and perched on her back, attempting copulation while he fluttered his wings. The female did not respond, remaining quiet. The male then perched beside her, and three times regurgitated a berry, each of which he placed in her open bill; she held her bill open for the last two. The female remained silent, while the male soon flew away to the nest. The previous day the male was seen twice to fly to the female, alight on her back, and attempt copulation, without offering her berries. Lack (Auk, 57: 169-178, 1940) does not mention courtship feeding in the Ptilonotidae, though Crouch has recorded it.

Frequently a male, perching silently in conspicuous places, nest building and giving display flights, did not secure a mate, though passing females were pursued, sometimes stopped and indulged in a display flight with him, visited his nest, and were fed by him. Sometimes he then forsook the territory or he then built another nest in it. One male, identified by a patch of dull feathers on his flank, built three nests in March without securing a mate; the nests were ten and twenty-five yards apart. It was only during the latter part of this period that this male began to sing occasionally; and it was only in late March that we heard the song of this species, so it seems probable that this is the customary thing here. This is contrary to Crouch's findings, who reported that song was used in establishing territory. Crouch also says that the males build false or dummy nests before they build the real one. In our experience a second nest was built only when the male was unsuccessful in securing a mate while building the first nest. Crouch also records that the 'false' nests are torn down and the material used in the real nest. We saw this twice, but on some other territories it definitely did not happen.

During this period before incubation started, the birds were conspicuous in their territory, especially the male. We saw no fighting, but when a strange male appeared, the resident male flew at him and the stranger retired. When other males flew over the territory the resident bird flew up and pursued them for a distance. The females sometimes drove off other females. The birds sometimes flew at Verdins, House Finches, and Gila Woodpeckers, causing them to move away.

During this pre-incubation period, even in the few days before egg laying, the male did not stay all the time on his territory, but occasionally made flights of several hundred yards, high in the air, to other localities. Sometimes he fed there, but this behavior had nothing to do with available food, of which there was an abundance near the nest. It was rather characteristic that these birds, especially the males, flew high, fifty feet or more above the ground, even when starting from a low perch, going but a short distance and descending to a low perch. The female appeared to feed in the territory more than did the male, but she also left it, though her actions were more secretive and her activity was more difficult to follow.

Incubation started with the first egg; both male and female incubated, but at one nest in the early part of incubation the male incubated more of the time than the female. However, the female spent

the night on the nest, as we found the female incubating at 9:30 P. M. at one nest the night after the first egg was laid. Once, when the female was laying, the male fed her. During a period of 1 hour and 37 minutes of watching a nest containing only the first egg (March 23, 1940) the male incubated for three periods of 1, 6 and 20 minutes; the female was on the nest for one period of 50 minutes, during which she laid the second egg and was fed four times by the male; the male also once chased a Gila Woodpecker from the vicinity of the nest during this time.

One nest was watched for a period of 1 hour and 20 minutes the day after the third egg was laid. The male alone incubated, though the female was about part of the time. During this time the male incubated for five periods of 5, 13, 17, 18 and 20 minutes, and was off, leaving the eggs uncovered, for four periods of 1, 2, 2 and 2 minutes respectively. The next day both male and female incubated; during a period of 1 hour and 2 minutes the male incubated for two periods of 12 and 5 minutes; the female for two periods of 24 and 10 minutes, and the nest was left uncovered for three periods of 2 to 5 minutes each. At another nest, four days after the clutch of three eggs was complete, a watch of 48 minutes showed the male and female incubating in a quicker rhythm; the female incubated for six periods of 1, 2, 3, 5, 7 and 7 minutes and was off for six periods of 1, 2, 2, 3, 7 and 8 minutes, while the male incubated for four periods of 1, 1, 4 and 6 minutes, and was off for four periods of 1, 8, 13 and 14 minutes, leaving the nest uncovered for six periods of 1 to 3 minutes. Thus, different birds spent varying times on and off the eggs. For instance, at one nest both male and female spent very short periods on the eggs—from 1 to 7 minutes; while at another nest the male incubated for as long as 20 minutes at a time.

The male and female frequently gave a little *kuk-kuk* call as one bird returned to brood, and the other often responded as it left the nest. Sometimes the call was given from as far as ten yards away from the nest and continued as the bird approached to take its turn at incubation. Sometimes one bird waited at some distance from the nest, where its mate joined it; sometimes both sat side by side for a time, before the incoming bird went to the nest. Softer *cru-ee* notes were also given when the birds changed places, as they passed each other near the nest itself. No other ceremony of alternation was observed.

Usually there were mistletoe berries growing on the tree containing the nest, and during incubation the female sometimes fed on

them there, only rarely flying a distance to feed. On the other hand the male still often flew off to some distance to feed, though occasionally he fed in the nest tree. Crouch mentions that when the birds are away from the nest they spend their time feeding. Perhaps food was more abundant in the locality where we studied these birds, for often we saw birds sitting quietly, sunning themselves, or preening, before coming back to the nest.

There was little active displaying during this period. No records were made of the high, circular flights so conspicuous during the nest-building time. Nor did the bird sing during this time, though both male and female often sat on high conspicuous perches, the male doing so more often than the female. Neither male nor female paid much attention to Verdins gleaning through the branches near the nests at this time. On one occasion a female *Phainopepla* left the nest where she was incubating and chased a male English Sparrow from the nest tree. At another nest the male left the nest to chase a Gila Woodpecker from the nest tree.

Territory defense evidently weakens during this period as at one nest containing three eggs we saw two males accompanying the female back to the nest from some distance away; a third male soon followed. The female paid no attention to them and went on her nest immediately. The males soon left of their own accord, to fly off toward the cottonwoods 200-300 yards away.

In five nests on which observations were made on the share of the sexes in care of the young, male and female took an equal part in the feeding, sanitation, and brooding. At one other nest, however, discovered when the young were a day or so old, the male alone cared for the young and there was no female about.

The food given the young was berries, and these the adult carried in its throat and regurgitated. One bird fed the young seven berries at one feeding. Both male and female were seen to wait at the nest and, when the young voided, to eat the excrement.

At one nest, when the young were a few days old, in one hour of watching the male fed three times, staying to brood each time for periods of 11, 6, and 13 minutes, respectively; the female also fed three times, staying to brood for 4, 5, and 5 minutes; the nest was uncovered for five periods of 1 to 6 minutes each; at another nest with small young, in 1 hour and 50 minutes the female fed five times, and settled to brood each time for periods ranging from 5 to 12 minutes in length, while in the same period the male fed three times, staying each time to brood for 4 to 8 minutes; the nest was

left unbrooded for six periods of 6 to 17 minutes duration. The same *kuk-kuk* calls were used to signal to each other, as the birds changed places at the nest, as were observed with incubating birds.

At the nest with only the male in attendance, when the young were one day old, he fed in one hour six times, and on five of these occasions after feeding, brooded for periods of 6 to 11 minutes, leaving the nest uncovered for periods of 1 to 10 minutes; five days later, in an hour he came to the nest and fed five times, and brooded three of these times for periods of 3 to 5 minutes, leaving the nest uncovered for periods of 3 to 15 minutes. On several other short visits to this nest no female was seen near it.

There was a decided difference in the general behavior of the birds with young and those that were incubating. While the birds at nests containing eggs did no displaying, these birds were conspicuous about the nest. The male and the female gave display flights in the vicinity of the nest and territory defense became prominent again; when a strange male appeared in the nest neighborhood, he was chased away at once by the resident male. The general behavior was similar to that of birds constructing nests. The birds did not customarily sing during the care of the young, any more than they did when incubating.

Crouch found that the male loses interest in the nest after the young are hatched, but this differs from what we saw. The male and female still shared equally in caring for the young, and in some cases the male was actively defending his territory. In the nest where the male alone was caring for the young, he paid little if any attention to intruders of his own or other species, though he occasionally sat up quietly on some conspicuous perch for minutes at a time.

SUMMARY

Near Tucson there were two influxes of most of the breeding birds, one in February and another in March. The first eggs were seen March 3; the last young in a nest, on June 12. The male *Phainopepla* established territories and advertised themselves visually, by conspicuous perching and display flights instead of singing. Nest building was started by the males before they were mated. Male and female indulged in courtship flights, and there was courtship feeding during pair formation. The female aided in completing the nest. When the male had finished a nest, and still had not secured a mate, he built another nest. Only after a period of displaying and nest building, during which he was unable to secure a mate, did a male sing. Usually male and female shared nest duties, but at

one nest the male alone fed the young. During incubation, territory defense and display flights were lacking, but appeared again after the young were hatched.

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CANADA GOOSE NESTS AND EGGS

BY CECIL S. WILLIAMS AND MARCUS G. NELSON

ASIDE from Bent's (1925) summarization, few comparative records of Canada Goose nest and egg sizes are found in the literature. It is felt, therefore, that the measurements of 174 eggs and more than 100 nests of geese breeding in northern Utah, and the comments on them, will be of interest.

Approximately 1100 pairs of Canada Geese (*Branta canadensis*) breed in Box Elder County, which is one of the northernmost in Utah. Two of the more productive breeding localities in the county are the Bear River Migratory Bird Refuge and the Bear River Silts lying between Brigham City and the Refuge. It was from nests on these two areas that the data herein presented were obtained. Although they constitute but a very small part of the available breeding grounds in the county, they are quite similar to the others, and it is unlikely that the factors influencing the goose population on the various areas differ markedly.

Studies on and in the vicinity of the Bear River Refuge during recent years have indicated some of the major attributes of good goose-breeding areas. Although these are of little concern to the present discussion, they are briefly enumerated for completeness: (1) a browsing area available to nesting birds and to paired adults prior to the nesting season; (2) an aquatic feeding area during the brooding period; (3) a brooding environment of open water and resting banks; (4) molting cover (emergents); (5) a browsing area for broods after they are on the wing (this may be the same as 1); (6) nesting sites isolated from interference; (7) nesting sites providing firm foundations; (8) nesting sites with good to excellent visibility. All these items seem to be essential, or at least very important, in determining breeding populations. Nesting sites are also selected for their proximity to channels and to open ponds that provide avenues to the brooding areas. Muskrat lodges are influential ecological factors, adding considerably to the nesting value of certain emergent environments, notably cat-tail and alkali bulrush.

Since the Canada Goose seldom constructs its nest of foreign materials, it is probable that nesting sites are selected on the basis of their inherent qualities and not on how they might be altered. The available nesting environments vary considerably in meeting the nesting requirements. In areas where suitable food, brooding cover, and molting cover are abundant, preference has been shown to hardstem bulrush, in which the nests are usually located on top of matted culms. Other plant environments utilized were saltgrass, weeds, banks, cat-tails, and alkali bulrush. As has been stated, muskrat lodges contribute considerable value to the two last-named covers.

Almost invariably the materials of which nests are constructed are of the plants in which the nests are located. Additional bolstering materials of other species are used if near at hand. Nests in saltgrass were found to have been occasionally strengthened with cockleburs, sunflower stems, and wire grass. In one instance, cow dung was used; in another, sago-pondweed that had been deposited on a channel bank by high waters of the previous year. Sticks and debris stranded in this manner probably influenced the selection of a few sites on more or less barren weedy banks. Foreign material was not used in nests in emergent vegetation except when located at borders or in mixed cover type. In two instances old heron nests were used; in another instance, that of a Marsh Hawk; and ten nests were on the sites of old goose nests.

The dull gray down is usually present in the nest soon after the first eggs are laid. By the time the clutch is complete and incubation begins, the nest consists of an outer loose framework of vegetation comparatively free of down; an inner layer of the thick warm down that serves as a blanket for the eggs during absences of the incubating bird; and a compact intermediate layer of smaller fragments of vegetation interwoven with down, which provides the actual form of the cup. Down is added to the nest structure all through the incubation period, especially if winds blow away some from the nest lining. Surrounding vegetation is also taken after incubation starts, as was evidenced by many nests, especially those in saltgrass, so that the nests become encircled by a clipped area as the season advances.

In Table 1 are presented the data obtained on depths of nests, cup diameters, and overall measurements.

It will be noted that two inches and five inches probably approach the lower and upper thresholds of nest depths. The random variations of nest depths between these points are possibly due to the

TABLE 1.—NEST MEASUREMENTS

| Depth | | Diameter (cup) | | Diameter (overall) | |
|---------|--------|-------------------|--------|-----------------------|--------|
| Inches | Number | Inches | Number | Inches | Number |
| | | | | 15 | 6 |
| | | | | 16 | 2 |
| | 4 | | | 17 | 1 |
| 2.00 | — | 6.0 | 1 | 18 | 4 |
| 2.25 | 18 | 6.5 | — | 19 | 1 |
| 2.50 | 7 | 7.0 | 6 | 20 | 3 |
| 2.75 | 22 | 7.5 | 5 | 21 | 5 |
| 3.00 | 4 | 8.0 | 11 | 22 | 11 |
| 3.25 | 19 | 8.5 | 24 | 23 | 6 |
| 3.50 | 3 | 9.0 | 33 | 24 | 5 |
| 3.75 | 16 | 9.5 | 4 | 25 | 9 |
| 4.00 | 2 | 10.0 | 16 | 26 | 6 |
| 4.25 | 5 | 10.5 | 3 | 27 | 6 |
| 4.50 | 1 | 11.0 | 3 | 28 | 4 |
| 4.75 | 4 | 11.5 | | 29 | 4 |
| 5.00 | | 12.0 | | 30 | 8 |
| | | 12.5 | | 31 | 5 |
| | | 13.0 | 2 | 32 | 4 |
| | | | | 33 | 1 |
| | | | | 34 | 2 |
| | | | | 36 | 4 |
| | | | | 37 | 1 |
| Average | Total | Average | Total | Average | Total |
| 3.2 | 105 | 8.9 | 108 | 25 | 100 |

availability of loose nesting materials. Cover type itself would seem to have little correlation since the range of difference between the cover-type means amounts to only 0.4 inch. The mean depth for all the nests was 3.2 inches, a figure that probably approximates the usual means for goose nests in mixed cover types.

Frequency figures of nest-cup diameters in Table 1 point to a rather definite mean of 8.9 inches for all cover types. There is, however, a range difference of 1.8 inches between the means of different covers, which indicates that smaller cups may be expected in weeds and saltgrass than in the emergents. Average diameters for the various covers were: hardstem bulrush, 8.2 inches; weeds, 8.5; saltgrass, 9.0; cat-tail, 9.0; and alkali bulrush, 10.0. Since few nest peripheries are exactly circular, the overall nest measurements were taken at the widest points. As will be noted in Table 1 where outside diameters

are tabulated, nests vary in width from 15 to 44 inches, and the average of 25 inches does not give an impression of stability. This is probably due to variations caused by the cover types themselves, whose means show a difference in range of 7.6 inches. Nests amidst emergent vegetation had the highest averages, being 27.9, 26.5, and 28.0 inches for hardstem bulrush, alkali bulrush, and cat-tails, respectively. Saltgrass averaged 23.1 inches, and weeds 21.3 inches.

TABLE 2.—EGG MEASUREMENTS

| Length | | Width | |
|-------------|--------|-------------|--------|
| Millimeters | Number | Millimeters | Number |
| 80 | 3 | 54 | 1 |
| 81 | 2 | 55 | 5 |
| 82 | 2 | 56 | 6 |
| 83 | 4 | 57 | 14 |
| 84 | 12 | 58 | 23 |
| 85 | 14 | 59 | 54 |
| 86 | 24 | 60 | 41 |
| 87 | 24 | 61 | 22 |
| 88 | 18 | 62 | 6 |
| 89 | 24 | 63 | 1 |
| 90 | 17 | 64 | — |
| 91 | 11 | 65 | 1 |
| 92 | 12 | | |
| 93 | 2 | | |
| 94 | 2 | | |
| 95 | 2 | | |
| 100 | 1 | | |
| Average | Total | Average | Total |
| 87.2 | 174 | 59.1 | 174 |

The eggs, which usually are a dull white when first laid, soon become stained with plant juices and dirt. It is often possible during the early stages of incubation to tell the order in which the eggs of a clutch were laid by the degree to which each is stained. The outer surfaces of the eggs are much smoother than those of the Ruddy Duck and attain a glossy appearance over the dirt as incubation progresses. Bent's (1925) compilation gives the average width and length of 84 wild Canada Goose eggs from various collections as 58.2 and 85.7 millimeters, respectively. As is evident from Table 2, the figures of this study compare favorably with his findings, the averages being 59.1 mm. in width and 87.2 mm. in length. The range

of variation in widths and lengths amounts to 11 and 20 mm., respectively. The measurements of the longest egg were 100 x 65 mm., and those of the shortest 80 x 56 mm. The widest egg was also the longest, but the narrowest measured 95 x 54 mm. Eggs in the same clutch did not show great variation in shape or measurements. One notable exception to this occurred in a clutch of four eggs, the individual measurements of which were as follows: 82 x 59; 87 x 59; 82 x 59; and 100 x 65 mm. It is interesting to note that the last-mentioned egg, an abnormally large one, hatched along with the others.

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Bear River Migratory Bird Refuge
Utah

RECORDS FROM THE TUCSON REGION OF ARIZONA

BY GEORGE MIKSCH SUTTON

THE writer spent a delightful month (May 16 to June 16) in the spring of 1940, becoming acquainted with the birds of south-central Arizona. In the present paper are listed some of the species noted during the earlier part of this period in the immediate vicinity of Tucson (from May 16 to 19) and in the Santa Rita Mountains, south of Tucson (from May 20 to June 4). Mr. Allan R. Phillips has been good enough to assist in choosing from the writer's extensive notes those data that appear to be deserving of publication at this time, as well as in checking carefully the subspecific identifications of all specimens collected.

Blue-winged Teal, *Querquedula discors*.—Adult male seen flying across an open field in farmlands south of Tucson, May 16. Adult male seen at Binghamton Pond, near Fort Lowell, May 17.

Lesser Yellow-legs, *Tringa flavipes*.—One seen at close range at Binghamton Pond, May 18. The few published records of this species from Arizona are all fall records.

Elf Owl, *Micropallas whitneyi whitneyi*.—Noted repeatedly in oak and other deciduous woodland in Madera Canyon in the Santa Rita mountains at from 4000 to about 5000 feet, May 20-25. Several breed-

ing specimens were taken. The stomachs of these were invariably (and exclusively) filled with middle-sized, hairless caterpillars. Neither Mrs. Bailey ('Birds Recorded from the Santa Rita Mountains in Southern Arizona,' Pacific Coast Avifauna, no. 15, 1923) nor van Rossem ('Notes on Birds in Relation to the Faunal Areas of South-Central Arizona,' Trans. San Diego Soc. Nat. Hist., 8: 121-148, 1936) lists the Elf Owl from the Santa Ritas.

Nighthawk, *Chordeiles minor*.—A single male was seen about Mt. Wrightson (in the Santa Rita Mountains) each evening from May 26 to 30. It spent the day high on a rocky ledge (at about 8800 feet) and flew about at nightfall, booming intermittently.

Broad-tailed Hummingbird, *Selasphorus platycercus*.—An almost-finished nest was found on a horizontal pine bough about fifteen feet from the ground on the east side of Mount Wrightson (at about 8000 feet elevation), May 27.

Red-shafted Flicker, *Colaptes cafer* > *auratus*.—A breeding male Flicker taken at Little Shot Spring in the Santa Rita Mountains, June 3, has a touch of red at either side of the nape; one yellowish rectrix; and one yellowish secondary in each wing. Finding this trace of *auratus* blood in a region so far removed from 'the East' is thought to be worthy of note.

Arizona Sulphur-bellied Flycatcher, *Myiodynastes luteiventris swarthi*.—This noisy, noticeable bird was fairly common in the Santa Ritas, among sycamores. Nine pairs were encountered—eight in Madera Canyon (from 4000 to about 6000 feet elevation) and one at Bog Spring. A bird was seen carrying nesting material, May 21. At Bog Spring, June 1, a pair which must have had a nest close by screamed and struck at the writer repeatedly.

Arizona Crested Flycatcher, *Myiarchus tyrannulus magister*.—Breeding pair noted repeatedly May 20-June 3, in sycamores and willows along the bed of Madera Canyon, at about 4000 feet elevation. Mrs. Bailey (1923) did not note this species during her stay in the Santa Ritas.

Western Flycatcher, *Empidonax difficilis*.—A nest with four fresh eggs was found in the bank beside the trail to 'Old Baldy' (Mt. Wrightson) in mixed oaks and pines at about 6500 feet elevation, June 3.

Coues's Flycatcher, *Myiochanes pertinax pallidiventris*.—Nest with three fresh eggs collected June 3 on the east side of Mt. Wrightson at about 8400 feet elevation. The nest was on a horizontal pine bough, about fifteen feet from the ground, and only ten or twelve feet from an occupied nest of the Western Tanager in the same tree.

Olive-sided Flycatcher, *Nuttallornis borealis*.—A female specimen (fat; ovary not enlarged) taken at about 8400 feet on the east side of Mt. Wrightson, May 28, is very small (wing, 99 mm., tail, 61). Zimmer ('Studies of Peruvian Birds,' Am. Mus. Novit., no. 1043: 13, 1939) has rather conclusively shown that two races of this species are not recognizable, and the capture of this small bird in Arizona probably should be regarded as additional evidence of range in size within the species as a whole rather than as a casual westerly occurrence of the eastern race '*cooperi*.'

Northern Violet-green Swallow, *Tachycineta thalassina lepida*.—A breeding male, taken May 30 on the east side of Mt. Wrightson (at about 8600 feet), is curiously colored, the entire upper parts being so dark and so little glossed with green and violet as to be almost blackish. The sides of the face and under parts are white, as in normal specimens. All the plumage of the back and upper rump is faintly barred. The writer has not encountered a comparable case of melanism anywhere among the Hirundinidae.

Bank Swallow, *Riparia riparia*.—On May 17 two very fat female specimens were taken from a flock of about sixty birds that circled over Binghamton Pond. The following day a few Bank Swallows were seen circling northward, four miles northwest of Tucson.

Cliff Swallow, *Petrochelidon albifrons*.—A single female taken at Binghamton Pond, May 17, being too white on the forehead as well as rather large for *P. a. tachina*, represents the northeastern race, *P. a. albifrons*. The wing measures 108 mm.; the tail, 48.

Purple Martin, *Progne subis subis*.—A male Martin taken at Binghamton Pond, May 17, represents this large northern race. Its wing measures 146 mm.; its tail, 74. A female taken at the same time (and apparently from the same flock) is small (wing, 135; tail, 71) and, though dark-throated and dark-breasted, represents the breeding race, *P. s. hesperia*.

Mexican Brown Creeper, *Certhia familiaris albescens*.—Noted frequently in the Santa Ritas—in the oak woods of Madera Canyon (at about 4500 feet elevation) as well as in conifers at higher elevations; on the east side of Mt. Wrightson; and in Florida Canyon. Full-fledged young were seen several times—first in Madera Canyon, in oaks, May 22. On Mt. Wrightson (at about 8000 feet) a nest containing well-developed young was found under a slab of pine bark, May 30.

Great Basin Hermit Thrush, *Hylocichla guttata polionota*.—As was strongly suspected by van Rossem some years ago ('Notes on Birds in

Relation to the Faunal Areas of South Central Arizona,' Trans. San Diego Soc. Nat. Hist., 8: 141, 1936), the Hermit Thrush breeds in the Santa Rita Mountains. The writer encountered several pairs at from 5000 to 7500 feet in and about Madera Canyon, and collected three males—one at Bog Spring, May 25; one at Little Shot Spring, where a nest with two eggs also was found, May 31; and one at Bog Spring, May 31.

These three birds are large for *polionota* (all have exactly the same wing and tail measurements—wing, 102 mm.; tail, 76.5), the average of twelve males from the White Mountains, Inyo County, California (the type locality) being: wing, 98.6; tail, 73.8 (see Grinnell, Condor, 20: 89, 1918). But they certainly cannot be called *auduboni*, for they are too gray above for that race, especially on the crown. In the light of this and other recent discoveries it would appear that *polionota*, far from being the local race that Grinnell considered it to be, is in fact a wide-ranging, southern Rocky Mountain form, the White Mountains birds representing only a fractional western part of the subspecies as a whole.

Azure Bluebird, *Sialia sialis fulva*.—On May 26 a breeding pair was encountered among pines, at about 8500 feet elevation, on the east side of Mt. Wrightson. The male was taken. This record appears to be the first for the Santa Ritas since the taking of the type series by Stephens in 1884.

Plumbeous Vireo, *Vireo solitarius plumbeus*.—A nest with three fresh eggs was found in a slender sycamore, near the bed of Madera Canyon at about 4500 feet elevation, May 24.

Audubon's Warbler, *Dendroica auduboni auduboni*.—A single male collected May 21, in oaks in Madera Canyon, represents this Pacific Coast race. It was the only one of its species seen that day and the last seen during the writer's stay. Its wing measures 75 mm.; its tail, 62.8.

Black-throated Gray Warbler, *Dendroica nigrescens*.—Common in scrubby woodland about Madera Canyon. At Bog Spring a stub-tailed juvenile female, not long out of the nest, was taken June 1.

Grace's Warbler, *Dendroica graciae*.—A stub-tailed juvenile male, just out of the nest, was taken near Little Shot Spring, June 3.

Red-faced Warbler, *Cardellina rubrifrons*.—Noted in the higher parts of the Santa Ritas, especially in the vicinity of Little Shot Spring and on the east side of Mt. Wrightson. At the latter place every aspen copse visited by the writer sheltered a pair of these handsome birds. A nest with small young, found May 29 (at about 8000 feet

elevation, on the ground in a low bank, under aspens) apparently represents an exceptionally early breeding date for the species.

Painted Redstart, *Setophaga picta picta*.—Common in the Santa Ritas. A dark juvenile male with full-grown flight feathers was taken in Madera Canyon as early as June 1.

Western Tanager, *Piranga ludoviciana*.—A nest with four eggs was found in a pine on the east side of Mt. Wrightson, at about 8400 feet elevation, June 3. This nest was in the same tree as a Coues's Flycatcher's nest that contained three eggs.

Lazuli Bunting, *Passerina amoena*.—A single male was noted at Bog Spring, May 25. It sang loudly and constantly all morning, behaving very much as if advertising or defending a nesting territory.

Pine Siskin, *Spinus pinus pinus*.—Although Swarth ('A Distributional List of the Birds of Arizona,' Pacific Coast Avifauna, no. 10: 51, 1914) calls the Pine Siskin "common in winter in the higher mountains of southern Arizona," he does not name the Santa Ritas among the ranges in which it has actually been found. Mrs. Bailey (1923) does not mention the species. On the east side of Mt. Wrightson the writer saw it repeatedly from May 26 to 30, collecting a breeding female (with distinct brood-patch) May 26, and a breeding male (with greatly enlarged testes) May 28. These are not long-winged enough for *S. p. macropterus*, the Mexican race. They measure: male—wing, 73.8 mm., tail, 48; female—wing, 73, tail, 48. A nest containing young, found May 28 high in a pine at about 8200 feet elevation, could not be examined closely. It was about sixty feet from the ground.

Red Crossbill, *Loxia curvirostra*.—Flocks of Red Crossbills were seen repeatedly in conifers on the east side of Mt. Wrightson from May 26 to 30, and at Armour Spring and in Florida Canyon on May 28. They kept high in the trees most of the time and were hard to collect. Five specimens were taken, four males and a female. All these were fat; all had been gorging on small, pale green larvae which must have been found on the conifers; all were molting more or less extensively; and none showed the slightest sign of sexual activity.

A male in mixed plumage, taken May 29, certainly is very close to the Mexican race, *L. c. stricklandi*. Though not quite so heavy-billed as two males in the Cornell University collection from Las Vigas and Mt. Orizaba, Veracruz (its bill-depth being 11.2 mm.) it is, nevertheless, a very large bird (wing, 99; tail, 58).

Two stubby-billed, red-plumaged males, taken May 27 and 28, also approach *stricklandi* in bill-size (bill-depth 11 and 11.2), but they are definitely small for that race (wing, 93.5 and 94.8; tail, 53.5 and 59).

They might be placed between "*grinnelli*" and *stricklandi*, or between *benti* and *stricklandi*, but it appears to be impossible, even with a good series of specimens at hand, to decide exactly what the differences between *benti* and "*grinnelli*" are!

A subadult male and an adult female taken May 28 are the slenderest-billed examples of the five, and compare very favorably with seven topotypical *benti* (from Grafton, North Dakota), courteously lent by the Museum of Zoology of the University of Michigan. They measure, respectively: wing, 93.3 and 90.2; tail, 56.5 and 53; bill-depth, 10.5 and 9.2.

Spurred Towhee, *Pipilo maculatus montanus*.—Noted daily in the Santa Ritas from May 23 to 30, but found to be much commoner in the evergreen-oak thickets high on the east side of Mt. Wrightson than anywhere in the low Upper Sonoran Zone of Madera Canyon. Young just out of the nest were noted May 30.

Scott's Sparrow, *Aimophila ruficeps scotti*.—A juvenile female, with full-grown flight feathers, was taken in Madera Canyon (at about 4000 feet elevation) on May 23.

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FURTHER ADDITIONS TO THE LIST OF BIRDS KNOWN TO BE PARASITIZED BY THE COWBIRDS

BY HERBERT FRIEDMANN¹

In the past four years, a number of new or interesting host records of the various cowbirds have come to my attention, which may now be added to previous compilations (The Cowbirds, 1929; Auk, 48: 52–65, 1931; Condor, 35: 189–191, 1933; Ibis, ser. 13, 4: 340–347, 1934; Wilson Bulletin, 46: 25–36, 104–114, 1934; Auk, 55: 41–50, 1938).

I am indebted to Mr. W. E. Unglish and Mr. H. R. Eschenberg of Gilroy, California, for a number of interesting records mentioned below.

Molothrus bonariensis (Gmelin). SHINY COWBIRD

To the 158 species and subspecies of birds listed as victims of the various races of the Shiny Cowbird, we may now add five more, bringing the total up to 163. These hosts involve three races of the Shiny Cowbird, as follows:

1. *Molothrus bonariensis bonariensis* (Gmelin). ARGENTINE SHINY COWBIRD

Pachyrhamphus polychopterus spixii (Swainson)

Paroaria coronata (Miller)

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The known hosts of this race of the parasite now total 115 forms.

2. *Molothrus bonariensis occidentalis* Berlepsch and Stolzmann. WESTERN SHINY COWBIRD

Mimus longicaudatus longicaudatus Tschudi

This brings the known victims of the Western Shiny Cowbird up to eight forms.

3. *Molothrus bonariensis minimus* Dalmas. SMALL SHINY COWBIRD

Holoquiscalus fortirostris fortirostris (Lawrence)

Loxigilla noctis barbadensis Cory

The list of hosts of this cowbird is hereby raised to a total of 26 forms.

Fuller data on these new hosts are presented below:

Pachyramphus polychopterus spixii (Swainson). Spix's Becard.—This bird has been found to be parasitized at Escobar, Buenos Aires Province, Argentina, whence Pereyra (Mem. Jardin Zool. La Plata, 9: 197, 1938) records a nest containing two eggs plus four of *Molothrus bonariensis*, January 19 (year not given).

Mimus longicaudatus longicaudatus Tschudi. Long-Tailed Mockingbird.—One record. Amadon (Auk, 57: 257, 1940) records a nest found near Lima, Peru, containing two eggs of the mockingbird and four of *Molothrus bonariensis occidentalis*, on February 9, 1913, by R. H. Beck, and now in the American Museum of Natural History.

Holoquiscalus fortirostris fortirostris (Lawrence). Barbados Grackle.—This grackle was first listed as a victim of *Molothrus bonariensis minimus* by Mrs. Anderson (What to See in the Barbados Museum: 34, 1937). Subsequently, Danforth (Journ. Barbados Mus. and Hist. Soc., 5, no. 3: 127, 1938) recorded a parasitized nest collected by K. C. Wood of Worthing, Christ Church, in the spring of 1937, which contained three eggs of the host and one of the parasite.

Paroaria coronata (Miller). Crested Cardinal.—All that is known of the Crested Cardinal as a molothrine host is the fact that it is listed as a victim of *Molothrus bonariensis bonariensis* in the north-eastern part of Buenos Aires Province, by Pereyra (Mem. Jardin Zool. La Plata, 9, pt. 2: 259, 1938).

Loxigilla noctis barbadensis Cory. Barbados Bullfinch.—One record; a nest with three eggs of the host and one of *Molothrus bonariensis minimus*, collected by K. C. Wood, at Britton's Hill, Christ Church, Barbados, August 23, 1937, and recorded by Danforth (Journ. Barbados Mus. and Hist. Soc., 5: 127, 1938). This set is now in the U. S. National Museum (no. 40082).

Molothrus rufo-axillaris Cassin. SCREAMING COWBIRD

This cowbird is parasitic almost entirely on the Bay-winged Cowbird, but recently has been found to lay eggs occasionally in the nests of other species. As far as known, no definite records exist of its young being raised by any of these occasional hosts; but there is no reason to suppose that this is in any way improbable. Pereyra (Mem. Jardin Zool. La Plata, 9, pt. 2: 260, 1938) writes that he has found (or been told by Señor Pablo Girard that he has found) eggs attributed to this cowbird in the nests of the following birds:

Furnarius rufus rufus (Gmelin). Rufous Ovenbird
Thamnophilus major major (Vieillot). Large Ant Thrush
Pitangus sulphuratus bolivianus (Lafresnaye). Bienteveo
Mimus saturninus modulator (Gould). Calandria
Turdus rufiventris rufiventris Vieillot. Red-bellied Thrush
Sicalis pelzelni Sclater. Yellow House Finch

The known victims of this cowbird now total eight species. It is possible that in some of these instances the nests used were not occupied by their builders, but by Bay-winged Cowbirds. However, this cannot be proved without more data than are available.

Molothrus ater (Boddaert). NORTH AMERICAN COWBIRD

To the 246 species and subspecies of birds listed as victims of the various races of this cowbird, we may now add twelve more, bringing the total up to 258. The additions are indicated by an asterisk in the following lists. These and a few other recent records involve three races of the cowbird (*buphalus* and *californicus* not considered valid forms) as follows:

1. **Molothrus ater ater** (Boddaert). EASTERN COWBIRD

- **Coccyzus erythrophthalmus* (Wilson)
- **Penthestes atricapillus atricapillus* (Linnaeus)
- **Vireo solitarius alticola* Brewster
- Vireo philadelphicus* (Cassin)

The known hosts of this cowbird now total 149 forms.

2. **Molothrus ater artemisiae** Grinnell. NEVADA COWBIRD

- **Steganopus tricolor* Vieillot
- **Oreoscoptes montanus* (Townsend)
- **Turdus migratorius propinquus* Ridgway
- Hylocichla guttata faxonii* Bangs and Penard

The Nevada Cowbird's list of victims is hereby increased to 92 forms.

3. *Molothrus ater obscurus* (Gmelin). DWARF COWBIRD

- **Vireo belli medius* Oberholser
- Xanthocephalus xanthocephalus* (Bonaparte)
- **Agelaius phoeniceus littoralis* Howell and van Rossem
- Euphagus cyanocephalus* (Wagler)
- **Spinus lawrencei* (Cassin)
- **Pipilo maculatus falcifer* McGregor
- **Junco oreganus montanus* Ridgway
- **Melospiza melodia samuelis* (Baird)

We now know 96 hosts for this race of the cowbird.

Fuller data on these and other recent records are presented below.

Steganopus tricolor Vieillot. Wilson's Phalarope.—Williams and Trowbridge (Auk, 56: 77, 1939) found two nests of this bird parasitized by Nevada Cowbirds at the Bear River Refuge, Utah, June 6, 1938. The nests were about twenty-five yards apart and were fairly well concealed in damp salt-grass on a small artificial island in the lower marshes. "Each contained four phalarope and two cowbird eggs. Since these instances seemed from available information to constitute a new host record, subsequent visits to the nests were made to learn the ultimate fate of the eggs. On June 21, it was found that all the phalarope's eggs in one nest had hatched and the two cowbird's eggs were left. These were later flooded. In the second nest, on June 28, three phalarope's eggs were found hatched. The remaining phalarope's egg was pipped but had been destroyed by flooding along with the cowbird's eggs. One of the cowbird's eggs in the first nest was evidently infertile, but the others were advanced in development."

Coccyzus erythrophthalmus (Wilson). Black-billed Cuckoo.—One record, a nest with a cowbird's egg, found apparently not far from Buffalo, New York, by Frank Morris and Edward A. Eames (Our Wild Orchids: 181, 1929). I am indebted to Mr. H. G. Deignan for calling this record, buried in botanical literature, to my attention.

Empidonax difficilis difficilis Baird. Western Flycatcher.—Previously known as a molothrine host from a single record, it has now been so recorded twice more. H. R. Eschenberg found a nest near Gilroy, California, April 28, 1932, with two eggs of the Flycatcher and one of the Dwarf Cowbird. W. E. Unghish found a similar combination of eggs at Betebel, California, June 1, 1937.

Pyrocephalus rubinus mexicanus Sclater. Vermilion Flycatcher.—To the few previous records may be added one more. Dille (Oologist, 57: 87, 1940) found a nest with one egg of the flycatcher and one of the Dwarf Cowbird near Nogales, Arizona.

Penthestes atricapillus atricapillus (Linnaeus). Black-capped Chickadee.—F. M. Packard (Bird Banding, 7: 129–130, 1936) found a nest of this bird containing four eggs of the chickadee and two of the cowbird, at the Austin Ornithological Research Station, North Eastham, Cape Cod, Massachusetts, on May 25, 1936. This is the first definite case of this sort to come to my attention.

Oreoscoptes montanus (Townsend). Sage Thrasher.—The Sage Thrasher had not been recorded as a cowbird victim until Twomey (Annals Carnegie Museum, 28: 456, 1942) found a nest parasitized by the Nevada Cowbird in the Uinta Basin, Utah, in the summer of 1937.

Turdus migratorius propinquus Ridgway. Western Robin.—Twomey (Annals Carnegie Museum, 28: 456, 1942) found a nest of this robin with an egg of the Nevada Cowbird, in the Uinta Basin, Utah, in the summer of 1937. This is the first case of its kind, so far as I know.

Hylocichla guttata faxoni Bangs and Penard. Eastern Hermit Thrush.—This thrush has long been known as a victim of the eastern race of the cowbird and is now recorded as a host of the Nevada Cowbird as well. Cowan (Occ. Papers Brit. Col. Prov. Mus., no. 1: 44, 1939) writes that of eight nests found at Tupper Lake, Peace River, British Columbia, seven were parasitized.

Corthylio calendula calendula (Linnaeus). Eastern Ruby-crowned Kinglet.—To the single previously known record may be added a second one reported by W. L. Holt (Auk, 54: 589, 1942) who found a kinglet feeding a young cowbird out of the nest at Scarboro Beach, Maine, July 22, 1941. The fact that the young cowbird was not seen in the kinglet's nest makes this record less definite than it would otherwise have been, as birds are known to respond to the food call of young birds they may not have reared themselves.

Vireo belli medius Oberholser. Texas Vireo.—Van Tyne and Sutton (Misc. Publ. Mus. Zool. Univ. Mich., 37: 94, 1937) record this vireo as a commonly parasitized victim of the Dwarf Cowbird in Brewster County, Texas.

Vireo solitarius alticola Brewster. Mountain Vireo.—Dickey (Oologist, 58: 111, 112, 1941) found a nest of this vireo with three eggs of the vireo and one of the cowbird near Cheat River, West Virginia, and another with a cowbird's egg embedded in its wall at Point Mountain, Randolph County, West Virginia.

Vireo philadelphicus (Cassin). Philadelphia Vireo.—Baillie and Harrington (Trans. Roy. Can. Inst., 21, pt. 2: 239, 1937) record that

C. E. Hope saw a Philadelphia Vireo feeding and caring for a young cowbird in Sudbury District, Ontario, July 18, 1937. This is not an entirely conclusive record, as birds are sometimes known to feed young that they have not raised, but it is probably a valid one. This vireo was previously known to be victimized by the Nevada Cowbird; this is the first instance of its being affected by the Eastern Cowbird.

Geothlypis trichas sinuosa Grinnell. Salt Marsh Yellow-throat.—To the single previous record may be added two more. W. E. Unglish found a nest at Soup Lake, Gilroy, California, on May 1, 1936, containing one egg of the warbler and one of the Dwarf Cowbird; H. R. Eschenberg found a similar set of eggs at the same place, May 25, 1935.

Xanthocephalus xanthocephalus (Bonaparte). Yellow-headed Blackbird.—Although often victimized by cowbirds of the eastern race and of the Nevada form, the Yellow-headed Blackbird has not been recorded before as a victim of the Dwarf Cowbird. H. R. Eschenberg found a nest at Los Banos, California, on May 9, 1936, containing a Dwarf Cowbird's egg in addition to four eggs of the blackbird.

Agelaius phoeniceus littoralis Howell and van Rossem. Gulf Coast Red-wing.—Nye (Oologist, 56: 87, 1939) has reported this race of the red-wing as a victim of the cowbird at Brenham, Washington Co., Texas. The cowbird in that area is the dwarf form, *M. a. obscurus*.

Agelaius phoeniceus californicus Nelson. Bicolored Red-wing.—To the three previously listed records may be added as many more. H. R. Eschenberg found a nest with three eggs of the blackbird and two of the Dwarf Cowbird at Gustine, California, June 12, 1934. W. E. Unglish found one with two eggs of each at the same place and date, and one with three eggs of the blackbird and one of the cowbird at Los Banos, California, June 10, 1937.

Euphagus cyanocephalus (Wagler). Brewer's Blackbird.—Hitherto recorded as a victim of other races of the cowbird, the Brewer's Blackbird may now be added to the list of hosts of the Dwarf Cowbird, on the basis of a parasitized nest found by H. R. Eschenberg at Gustine, California, June 6, 1932. The nest contained three eggs of the blackbird and one of the cowbird.

Piranga rubra cooperi Ridgway. Cooper's Tanager.—Van Tyne and Sutton (Misc. Publ. Mus. Zool. Univ. Mich., 37: 94, 1937) list this tanager as a victim of the Dwarf Cowbird in Brewster County, Texas. In a letter under date of September 8, 1942, Sutton informs me that on May 15, 1935, he and J. B. Semple saw a pair of Cooper's

Tanagers feeding a young cowbird near Hot Springs, along the Rio Grande. The cowbird appeared to be the only young bird of the brood. This tanager was previously known as a molothrine victim only on the basis of its inclusion in Bendire's list.

Spinus pinus pinus (Wilson). Northern Pine Siskin.—To the three previously listed instances of this bird as a victim of the Eastern Cowbird may be added three more—all in Wellington County, Ontario (Klugh, A.B., Ont. Nat. Sci. Bull., no. 2: 17–18, 1906). These records were previously overlooked as the paper in which they appeared was unknown to me.

Spinus lawrencei (Cassin). Lawrence's Goldfinch.—H. R. Eschenberg found a nest with four eggs of the goldfinch and one of the Dwarf Cowbird at Gilroy, California, June 20, 1934. In the Museum of Vertebrate Zoology at Berkeley, California, is a set of one egg of this goldfinch and two eggs of the Dwarf Cowbird, collected by Ashworth at Candalanga, Ventura Co., California. These two records serve to add this species to the list of molothrine victims.

Pipilo maculatus falcifer McGregor. San Francisco Towhee.—One record—a nest with three eggs of the towhee and one of the Dwarf Cowbird, found by H. R. Eschenberg at Betebel, Santa Clara Co., California, May 18, 1936.

Aimophila aestivalis bachmani (Audubon). Bachman's Sparrow.—To the two records of my earlier lists may be added a third. Brooks (Wils. Bull., 20: 100, 1908) reports a nest with three eggs of the sparrow and one of the Eastern Cowbird near French Creek, West Virginia.

Junco oreganus montanus Ridgway. Montana Junco.—One record—Cowan (Occ. Papers Brit. Col. Prov. Mus., no. 1: 59, 1939) found a parasitized nest at Tupper Lake, Peace River, British Columbia, May 20, 1938. The nest was deserted later.

Melospiza melodia samuelis (Baird). Samuel's Song Sparrow.—This race of the Song Sparrow may be added to the list of victims of the Dwarf Cowbird on the basis of a nest with three eggs of the sparrow and two of the cowbird, found by H. R. Eschenberg at Soap Lake, Gilroy, California, May 18, 1935.

***Tangavius aeneus* (Wagler). BRONZED COWBIRD**

To the previously known hosts of this cowbird, Amadon (Auk, 57: 257, 1940) has added one more—*Arremonops rufivirgatus rufivirgatus* (Lawrence), the Texas Sparrow.

U. S. National Museum
Washington, D. C.

LIGHT REQUIREMENTS OF THE WEAVER FINCH¹

I. LIGHT PERIOD AND INTENSITY

BY MARIE ROLLO AND L. V. DOMM

IN previous experiments (Brown and Rollo, 1940) it was shown that certain equatorial whydahs and weavers in eclipse plumage responded to increased daily light periods by assuming nuptial plumage. *Steganura paradisea*, *Pyromelana franciscana* and *Vidua principalis* assumed nuptial plumage out of season on daily light periods that were gradually increased from ten to sixteen hours. However, the plumage change did not come about until several months after the sixteen-hour period had been reached, which brought up the question as to whether the assumption of nuptial plumage was due to the gradually increasing daily light period or to the effect of the sixteen-hour period as such. The length of the daily light period as well as the intensity used in the above experiments were more or less arbitrarily chosen. Therefore the following experiments were undertaken to see:

- I. At which day-lengths *Pyromelana* would assume nuptial plumage.
- II. If there was an optimum day-length for producing nuptial plumage.
- III. The relative effects of gradually increasing periods and of a constant optimum period, if any, throughout the experiment.
- IV. The relationship between light intensity and daily light period in bringing about the molt.

MATERIAL AND METHODS

Thirty-nine male *Pyromelana franciscana*, in eclipse plumage, were used in the experiments. Thirty-two of them were purchased in California and were said to be mature birds that had been in nuptial plumage once before. The other seven birds were three and five years old and had been previously used in the experiments by Brown and Rollo (1940) mentioned above, in which the birds, their origin, and general care were described.

A wooden rack, divided into compartments, 14 x 24 x 20 inches high, was built with a light socket attached to the center of the ceiling and a dark green roller shade on the front or open side of each compartment. A one and one-half inch frame extended over the shades on all four sides and prevented any leakage of light. Lights were turned on and off by individual time switches. The birds were examined weekly

¹This investigation was aided by a grant from the Dr. Wallace C. and Clara A. Abbott Memorial Fund of The University of Chicago.

for the first appearance of nuptial plumage. The bright orange nuptial feathers appear first at the vent and can be distinguished from the drab of the eclipse plumage, even before they emerge from the sheath. At the completion of the molt, the last drab feathers that remain are at the sides of the abdomen and when these drop off the bird is in full color or nuptial plumage. The progress of the molt in *Pyromelana* is very regular and definite, making these birds particularly good material for a study of this kind.

RESULTS

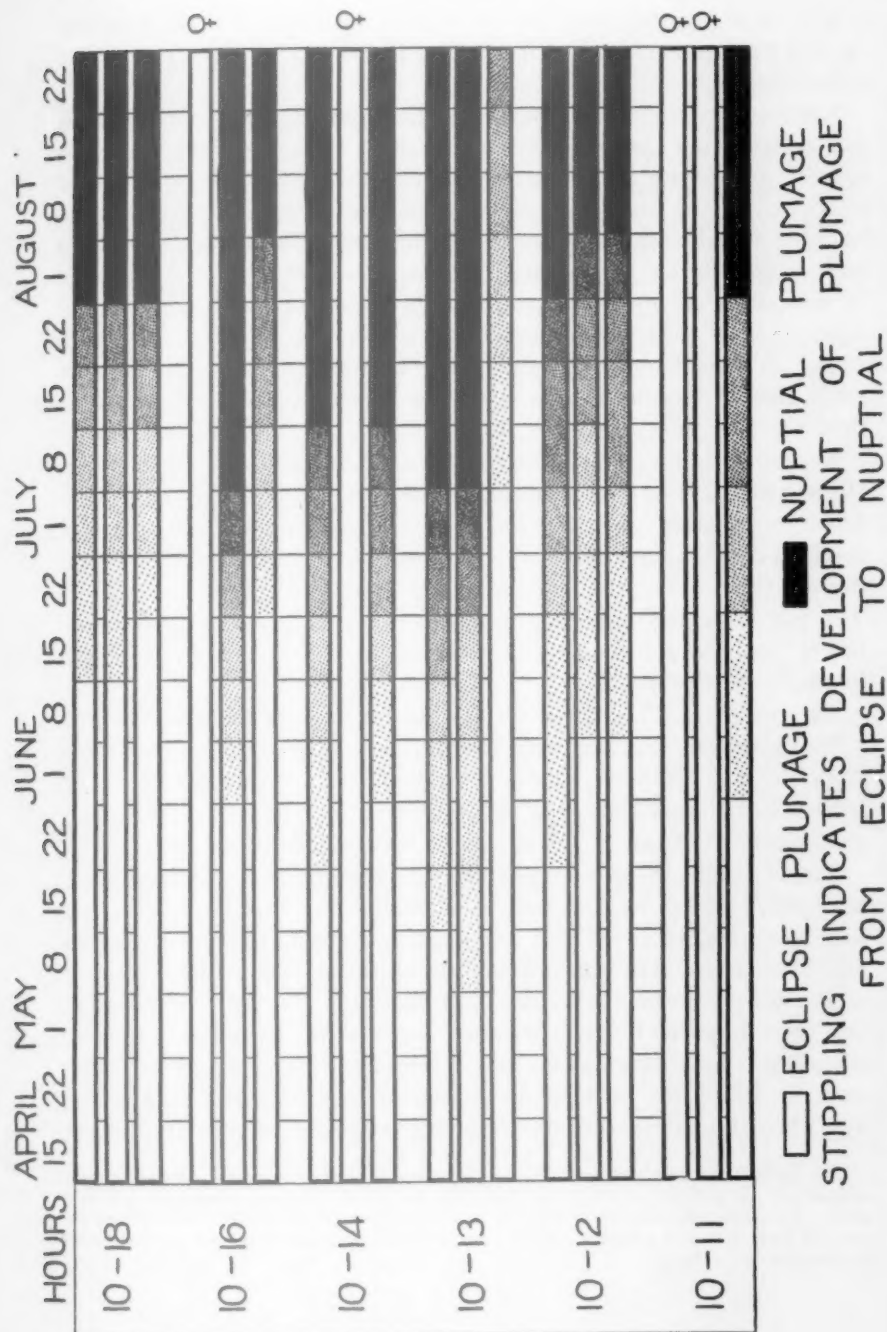
I. EXPERIMENTS ON LIGHT PERIOD

The experiments on light period were done in a room with west exposure. There were four west windows and the rack was placed against the north wall. All shades were raised at 7:30 A. M. and the birds received daylight from then until 5:30 when the artificial lights were turned on as needed. The shades were drawn when the desired light period had been obtained and the birds were then in total darkness until 7:30 the next morning. One-hundred-watt bulbs were used for the artificial lights.

Experiment 1.—On February 20, 1939, three birds were put into each of six cages and started on a ten-hour daily light period. This was increased ten minutes a day until one of the following periods was reached in each of the six cages—eleven, twelve, thirteen, fourteen, sixteen, and eighteen hours. They were then kept at that light period until the close of the experiment at the end of August. Due to the difficulty in sexing the birds when they are in eclipse plumage, four turned out to be females. The males on all periods came into nuptial plumage. However, those on the thirteen-hour period were first to start the molt and first to complete it. The first indications of a response in this group were noticed on May 8 and the birds were in full color by July 8. Longer and shorter periods retarded the appearance of nuptial plumage, an eighteen-hour period producing essentially the same results as an eleven-hour period. Thirteen hours, therefore, seemed to be the optimum period for producing this change. The results of this experiment are diagrammatically shown in Text-fig. 1.

Experiment 2.—This experiment was started at the same time as the above. Two birds were put into each of seven cages and given constant light periods of ten, eleven, twelve, thirteen, fourteen, sixteen, and eighteen hours from the start of the experiment. All of them assumed nuptial plumage. Although the response in these birds was

APRIL 15 22 1 8
 MAY 1 8 15 22 1 8
 JUNE 1 8 15 22 1 8
 JULY 1 8 15 22 1 8
 AUGUST 1 8 15 22 1 8



TEXT-FIGURE 1. Graph showing the assumption of nuptial plumage in birds receiving increasing daily light periods.

a little less regular than in those of Experiment 1, the constant light periods were equally effective as, if not more effective than, the increasing ones.

Unfortunately, the two birds on the thirteen-hour period, which proved to be the optimum in Experiment 1, turned out to be females. Of the remaining periods, the fourteen-hour period was the most effective and the birds on it showed the first indication of a response on May 7 and were in full color by June 15. The longer periods as well as the shorter ones retarded the appearance of nuptial plumage as was observed to be the case in Experiment 1, one bird in the eighteen-hour cage responding the same week as one in the ten-hour cage. It is evident that the plumage responds to the length of the daily light period as such and not to the gradual daily increase or decrease (see Text-fig. 2).

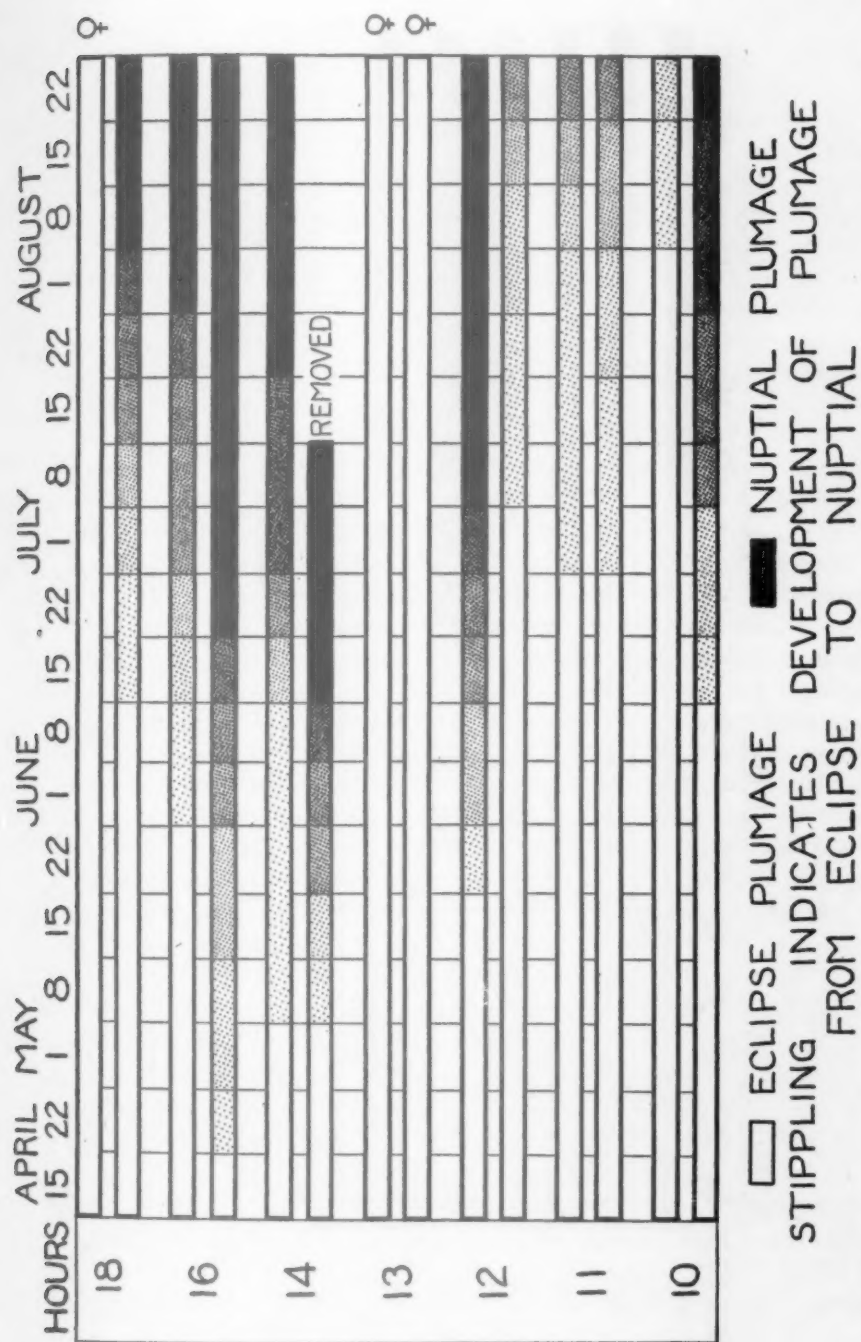
Experiment 3.—Seven older birds used in previous experiments (Brown and Rollo, 1940) and thus having varying light histories, were put into the same cages with the birds in Experiment 2 and therefore received identical treatment. They responded irregularly, but all but one on the ten-hour period came into nuptial plumage by July 15. The one in the ten-hour cage remained in eclipse plumage. No correlation was found between their response and their previous light history (see Text-fig. 3).

Experiment 4.—The bird in the ten-hour cage in Experiment 3, in eclipse plumage, and one from the fourteen-hour cage in Experiment 2, in nuptial plumage, were killed and dissected on July 15. The former had gonads about the size of a pin-head; the latter, almost one centimeter in diameter. No histological examinations were made.

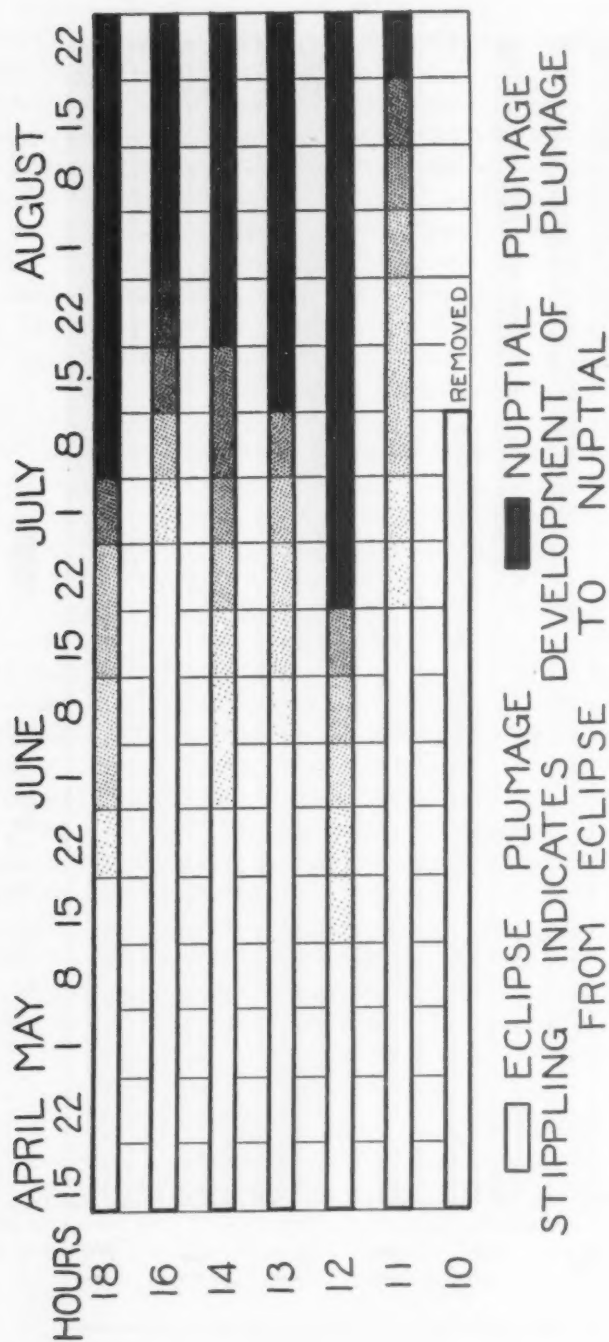
The remaining birds were put into an aviary and kept on a fourteen-hour light period until February 18, 1940. On that date they were still in nuptial plumage and twenty-six of them were put into a cage and given a period of nine hours of daylight indoors.¹ The remaining eleven were kept on a fourteen-hour period. The light periods during the last part of the experiment were rather irregular, the birds sometimes receiving a slightly longer period than was intended. However, by July 6 the birds in the nine-hour cage were in eclipse plumage, while those in the fourteen-hour cage were still in nuptial plumage.

¹On April 14, the food was removed from the nine-hour cage about noon. This was not discovered until 6:00 P. M. by which time five birds were dead and many others were in convulsions. Those that were able to eat were fed, and those that were not were put on a heating pad and fed warm milk with a pipette. There were no further losses and those that survived seemed to have suffered no harm.

APRIL MAY JUNE JULY AUGUST
15 22 1 8 15 22 1 8 15 22



TEXT-FIGURE 2. Graph showing the assumption of nuptial plumage in birds receiving various daily light periods, not increasing in length.



TEXT-FIGURE 3. The assumption of nuptial plumage in birds with varying previous light histories.

II. EXPERIMENT ON LIGHT INTENSITY

For this experiment the rack was placed in a darkened room where the birds received fourteen hours of artificial light and no daylight. Seven compartments were used with 7½, 15, 25, 40, 60, 100, and 150-watt bulbs, respectively. The intensity was measured in foot-candles in the three places where the birds spent most of their time, the center of the floor and the center of each of the two perches. These three figures were averaged to give the approximate number of foot-candles of light that the birds received.

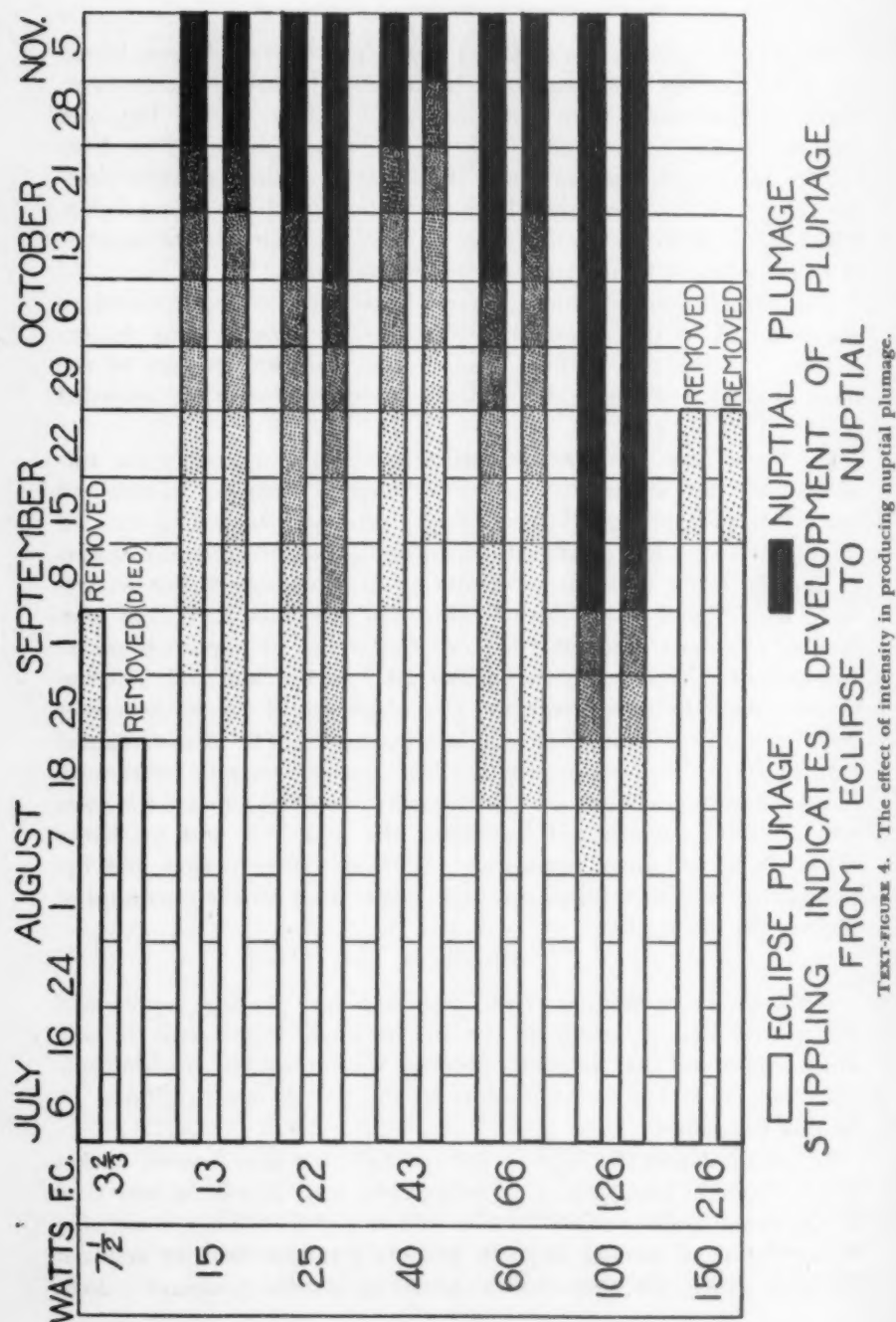
The birds in nuptial plumage showed no change and were therefore not recorded in the text-figure. They were removed from the experiment at the end of four weeks. The plumage changes of the birds in eclipse plumage at the start of the experiment are recorded below (Text-fig. 4).

We found that any intensity within the limits necessary for survival of the bird seemed to produce the nuptial plumage. Three and two-thirds foot-candles (7½-watt cage) retarded the appearance of nuptial plumage and produced convulsions. One bird died on August 25 and the other went into convulsions on September 8, but was revived with higher intensities of light. On the other hand, 216 foot-candles (150-watt cage) retarded the appearance of nuptial plumage and produced tremors by September 29. At the low and high intensities both the appearance and rate of growth of the feathers were retarded but no eclipse feathers were regenerated. The birds remained bare in spots. Approximately 126 foot-candles seems to be the optimum intensity, as birds on this intensity were first to start the molt into nuptial plumage and completed the molt five and six weeks before those on other intensities. With optimum period and optimum intensity these birds can be brought from eclipse into nuptial plumage in ten weeks.

DISCUSSION

It was shown by Witschi (1936) that the henny plumage represented the neutral basic plumage in the weaver finch, *Pyromelana franciscana*. He found that the cock's plumage was induced by gonadotropic hormones and that its expression in the female was inhibited by ovarian hormones.

By manipulating the light period and light intensity, weaver finches can be brought into nuptial or eclipse plumage, at will, at any time of the year. Daily periods from eleven to eighteen hours, consisting of ten hours of normal daylight indoors supplemented by artificial lights at about 126 foot-candles, produced nuptial plumage. Birds



receiving thirteen or fourteen hours daily responded first and the others in direct proportion to the number of hours that the period was above or below the optimum.

In another experiment birds receiving a fourteen-hour period, at intensities ranging from $7\frac{1}{2}$ to 126 foot-candles, also assumed nuptial plumage, with the optimum, judging by the fact that it produced nuptial plumage in the shortest time, at about 126 foot-candles. The lower and higher intensities, $3\frac{1}{2}$ foot-candles and 216 foot-candles, did not facilitate survival of the birds and after prolonged treatment caused tremors and convulsions followed by death.

From time to time, birds in various stages of the molt were dissected. The gonads of those in full nuptial plumage were always between seven and ten millimeters in diameter while those of birds in eclipse plumage were from one to two millimeters in diameter. Birds in intermediate plumage sometimes had two gonads of intermediate size and at other times one fully developed gonad and one much smaller.

Light period and light intensity are two separate factors and one cannot be substituted for the other. Burger (1939) demonstrated that light intensity can only modify spermatogenesis in the male starling, but cannot be substituted for proper daily length of exposure. In other experiments, not recorded in this paper, weaver finches went into eclipse plumage on a nine-hour period in spite of an intensity of 350 foot-candles. Burger also found that increases beyond a certain period did not progressively produce a further acceleration of spermatogenesis. In our experiments, any light period longer than fourteen hours not only did not accelerate, but actually retarded, the appearance of nuptial plumage. This also held true for intensity.

Bissonnette (1937) states that regression and prolonged refractory periods invariably follow maximal activity, with or without environmental stimulation. In our experiments, weaver finches, on optimum period, did not show regression or refractoriness if we can assume that there is always a correlation between plumage and the state of the gonads. Several have been kept in perfect nuptial plumage for eighteen months and, in one case, for four years. However, on a period above the optimum, as well as on one below, they show what may be signs of regression; they develop shabby rectrices and remiges and become bare in spots and some actually molt and regenerate a few primaries. It is interesting to note that feathers which are the same color in both nuptial and eclipse plumages, such as remiges and rectrices, are replaced when molted as the result of too long a

light period while those that are different in color, orange in the nuptial and drab in the eclipse plumage, such as tail coverts, ruff and short body feathers, are not so readily replaced. This is the reason the birds become bare in spots.

If these can be called signs of regression, it may explain the fact that starlings normally show signs of regression of the gonads before the fifteenth of June, when the days are still increasing. Birds apparently inherit the ability to respond to a certain light period and a certain intensity. This period probably corresponds with the length of the daily light period at the latitude in which the birds originated.

Our domestic fowl originated at about the same latitude as the weaver finch (Rice and Botsford, 1940) and responds to the same light period. This is shown by the fact that poultrymen, in order to obtain increased egg production, add enough artificial light to produce a thirteen or fourteen-hour day when the days are short. However, they do not shorten the period when it is above the optimum in nature at this latitude and it is during this time that certain perplexing problems, such as "early molt," cannibalism, and drop in egg production, are encountered by the poultryman. A weaver finch on too long a light period, with its bare back, shabby, broken feathers, and sporadically regenerating primaries, is a miniature picture of a hen in an "early molt." The summer drop in egg production which is usually attributed to high temperatures also occurs at this time and may be related to this fact. It is therefore possible that the normal light period above the optimum is responsible for some of these difficulties in poultry and experiments are under way to see if such a relationship actually exists.

SUMMARY

Thirteen to fourteen hours is the optimum daily light period necessary for producing nuptial plumage in *Pyromelana franciscana*.

Longer as well as shorter daily periods were found to retard the appearance of nuptial plumage.

On optimum light period and optimum intensity these birds can be brought into nuptial plumage in ten weeks at any time of the year, or kept in nuptial plumage year after year.

On a nine or ten-hour period, birds in eclipse plumage do not assume nuptial plumage and birds in nuptial plumage molt into eclipse plumage.

On an excessively long light period, birds in nuptial plumage sometimes go into a partial molt.

There is a correlation between the size of the gonads and plumage changes.

Given enough time, any intensity sufficient for the survival of the birds will produce nuptial plumage provided that they have the optimum period.

The optimum light intensity is about 126 foot-candles.

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NEST LIFE OF THE EASTERN YELLOW WARBLER

BY F. G. SCHRANTZ

INTRODUCTION

THE data on which this paper is based were obtained from a careful study of forty-one nests of the Eastern Yellow Warbler (*Dendroica aestiva aestiva*), carried out during the summers of 1938 and 1939 at the Iowa Lakeside Laboratory, on West Okoboji Lake. The labora-

tory grounds where these nests were found is a restricted area with no domesticated animals. During the summer of 1938, nine nests were located in bushes of wolfberry (*Symphoricarpos occidentalis*) and three in young saplings of box elder (*Acer negundo*). These nests had an average height of two and one-half feet from the ground, with a range of two to four feet. One other nest was found in a cottonwood (*Populus deltoides*) at a height of about ten feet. In 1939, eighteen nests were located in bushes of wolfberry, five in young saplings of box elder, two in wild gooseberry (*Ribes gracile*), one in wild currant (*Ribes floridum*), and one in an introduced species of honeysuckle. The average height of these nests was also two and one-half feet from the ground, ranging from one and one-half to five feet. Another nest was built in a box elder at a height of about fifteen feet.

Nests were marked by driving a common lath into the ground nearby with attached linen shipping tag representing the nest number.

In 1938, daily observations on nests were begun on June 14, at a time when one nest contained young. In 1939, daily observations on nests were begun on June 6, with two nests containing young. With this and other recorded data on time of egg laying, the bird life in the summer of 1939 was over a week in advance of 1938. The reason for this may have been a drier and earlier spring in 1939.

Data include part-time observation on one of the nests while being built, with a total of forty under daily observation until after the fledglings had left the nest. The nest in the box elder was visited only occasionally because it was difficult to approach. The main objectives in this project consisted of weighing and measuring a large number of eggs, as well as weighing some of the young for a period of days to determine their gain in weight. This gain in weight was checked against nests containing a varied number of young, as well as gain in weight of first- and last-hatched young in a nest. A check was also made to determine the size of the first- and last-laid egg of a nest, in order to find out if the first egg laid would be the first to hatch.

Weighing of eggs and young was carried on in the field with a small balance reading directly to one-tenth of a gram. The balance and a circular spirit level were fastened inside a plywood box with only one side open. A coiled spring with attached hook was fastened inside the box and used for holding the balance beam and pans in a fixed position while traveling in the field. The box and its contents were mounted upon a wooden photographic tripod. Since the entire

apparatus weighed only five and one-fourth pounds, it was convenient for carrying.

Egg measurements were made in a small three-sided wooden box having a base with a mounted metric scale reading directly to one-tenth of a centimeter. With the use of a sliding wooden block, readings could readily be taken from the mounted scale. In manipulation of eggs and young, great care was exercised to avoid injury to either. It was found very convenient to use a common teaspoon in transferring eggs to and from the nest. Also, the spoon was helpful in lifting young from the nest, and to avoid any great temperature change the spoon was always carried in the side trouser pocket next to the body. Filter paper folded in the form of a cup was used as a receptacle for the young while on the balance.

NEST BUILDING

One nest was discovered in the first stages of construction, and from that time on it was watched on an average of two hours a day for four days until it was completed. Observations were made from about 7:30 A. M. to 8:30 A. M. and from about 6:30 P. M. to 8:00 P. M. In addition to this it was viewed occasionally throughout the day. Construction was first observed at 7:45 A. M., on June 12, 1939, when a female Yellow Warbler was seen carrying a tuft of plant-down into a small box elder sapling. Upon examination, a mass of plant-down about one and one-half inches in diameter was found at a measured height of two feet three inches from the ground in the fork of the sapling. During an hour of observation the female continued to carry plant-down at intervals of about four minutes although once it did not bring any material for twenty minutes. At noon the plant-down mass had increased to about three inches in diameter and was more compactly pushed into the fork. By 6:45 P. M., there were many strands of plant fibers and grasses woven around and through the plant-down in such a way as to wrap and bind the plant-down around the small twigs of the fork. The nest was just assuming a cup-shaped structure. The female was now bringing large loads of a mixture of grasses and plant fibers and working at a rate of about one trip every four minutes. This first day's building was completed at 7:55 P. M. The nest was now partially surrounded with woven plant fibers and grasses with a slight formation of a rim.

At 7:30 the next morning, building was again in progress but at a slower rate. There was a soft intermittent rain and both birds spent much time in a nearby tree as if feeding. Only six trips of the

female at very irregular intervals were observed in an hour. The material brought still consisted of fibers and grasses and by noon the nest had acquired a pronounced cup-shape due to the rim being built up higher. This rim consisted of plant fibers and grasses woven partly into the original down but mostly into the sides and around the top. At 6:45 P. M., the nest appeared completed with a well-formed cup, plant-fiber and grass rim, and a plant-down floor. However, the female was later observed bringing more plant-down. This she continued to do at about six-minute intervals until 7:45 P. M. The nest at this time had not undergone further changes, but the cup was almost filled with loose plant-down.

On the third day there was a cold rain which lasted until noon. The afternoon was partly clear, but later in the day a drizzling rain fell. Very few observations were made on the nest, and the only time the warblers would appear was when the author approached within a few yards of the nest. By 8:00 P. M., no progress in nest building was apparent since the preceding evening. The cup of the nest was still partly filled with loose plant-down which appeared damp but not soaked with the rain.

By 8:00 on the fourth morning, the plant-down inside the nest was smoothed out and contained a few strands of fine grasses. The female was sunning herself on a nearby weed stalk and hovered close to the nest. She did not carry any nest material at any time during the day's observation, but at nightfall it seemed as if the nest contained a little more plant-down which covered all exposed grasses. During the evening observation, both birds seemed to be content for they were feeding and chirping in close company in a large tree within twenty yards of the nest. At 6:30 A. M., the following day, one egg was found in the nest.

During all the observations on the building of this nest the male at no time was seen to bring any nest material. However, since there were many hours during the day when no observations were made, it is possible that he might have helped at some time. While the female was busy carrying the nest material the male was constantly present in nearby bushes or trees chirping softly and at times would burst into song. He appeared to be feeding frequently. Once he sang for twenty minutes at four- to five-minute intervals and then began feeding again. The presence of an observer at a distance of about thirty-five feet from the nest may have had some effect upon his actions since he did not take part in the nest building, but he never complained audibly after the observer was seated and quiet in the observation spot.

The dates of the beginning of construction and the dates the first eggs were laid were obtained for two other nests, and the time which elapsed in both cases was four days. From these data and from the observations described above it seems as if four days are probably required from the beginning of nest building to the laying of the first egg. However, one other nest was found in a completed condition and it was five days before it contained an egg. The following day it contained two eggs but was deserted five days after the appearance of the first egg.

Examination of twenty-eight nests revealed many variations in the linings: thirteen nests had a lining of fine grasses; five of grasses and few feathers; five of plant down and grasses; two of plant down only; one of plant down, grasses, and hair; one of plant down, hair, and feathers; and one of grasses and hair. All except six had a pronounced outer covering of plant fibers and a few grasses. Of these six, four were surrounded with plant down and plant fibers, and the two others had a large amount of plant down toward the bottom on the outside of the nest. The inside diameter measured at the rim of all twenty-eight nests was one and three-quarter inches with a variation of not more than one-sixteenth of an inch. After the young hatched and were becoming fledglings the nests in many cases became distorted due to the crowding of the young and to weathering.

Some variation in the height of the nests was also noted. This depended upon whether the nest was placed in the forks of bushes and saplings or if it was mostly attached to a main branch of a partly forked plant. In cases of attachment to a main branch of a partly forked plant there was usually a small amount of plant fibers or plant down streaming down from the nest, but the nest proper always assumed a well-formed cup-shape. Some nests placed in narrow forks as found in wolfberry bushes were cone-shaped, due to the nest material being placed down in the very fork and built up from this point. This formed a higher nest than those built in a wide fork. In narrowly forked plants the nest was seldom attached to the forks, while in slightly forked branches the nest material was woven around one or more of the branches. This weaving of nest material around a branch was especially noted where the nests were built in gooseberry or currant bushes, for then one side of the nest was heavily wrapped around one stem which served as the main support. The height of nests also depended upon whether or not Cowbird eggs had been deposited in them; under the former conditions there were many two-story nests. On examination of all forty-one nests studied, those

which were parasitised by Cowbirds had one or two Cowbird eggs deposited in them during varying stages of nest construction. Eggs appeared so deep in some nests that they must have been deposited there before completion of the original nest lining. In one case a Cowbird egg was found lying at the bottom of a nest in the fork of a wolfberry and so sparsely surrounded with plant material that it was partially visible from the outside. No information was obtained concerning the method of deposition of the Cowbird eggs in the nests. Parasitism of nests by Cowbirds has been discussed by Friedmann (1929), Roberts (1932), Shaver (1918), and Stephens (1917).

Of the thirteen nests studied in 1938, one contained Cowbird eggs buried with two of the warbler eggs. A second story was built to this nest which later contained three warbler eggs. Two other nests each contained a buried Cowbird egg. Another nest contained a buried Cowbird egg and the second and final story contained one Cowbird and two warbler eggs. In 1939, of the twenty-eight nests studied, eight contained one or more Cowbird eggs. Seven of these contained a buried Cowbird egg. One had two exposed Cowbird eggs and two warbler eggs, but three days after the second Cowbird egg was deposited one warbler egg disappeared and one the following day the second warbler egg disappeared. The next day the nest was found torn apart and the two Cowbird eggs were lying on the ground uninjured.

In all nests of 1939, there was not a single case of the warblers using the previous year's nests. In fact, only one of the previous year's nests was found. All other nests had disappeared. The cause for the disappearance of the nests was not determined, but they were probably destroyed by wind or other elements. The nest which remained was the one in the cottonwood tree in which only a small amount of weathered plant down was left attached in a small crotch.

Territories appeared definitely proclaimed, for males and females were often seen driving an intruding warbler from the vicinity of a nest. This was especially noted in 1939 in one area having six nests in a group of wolfberries which grew in clumps of about fifteen to thirty feet in diameter. Each clump contained but a single nest. The distances between nests were stepped off as follows: nest 22 to nest 44, twenty-four yards; nest 44 to nest 24, eighteen yards; nest 24 to nest 23, nineteen yards; nest 24 to nest 25, nineteen yards; nest 25 to nest 26, thirty-three yards; and nest 26 to nest 27, thirty yards. An adjoining area outside the laboratory grounds contained as many or more clumps of wolfberries, but the height of these bushes was

lower because of the grazing of cattle in the summer of 1938. In 1939, there were no cattle in this adjoining area but the warblers did not use this area for nest building. The wolfberries, however, seemed tall enough for nests as compared with those used in other areas. Therefore, it is possible to conclude that although the warblers are hostile to their own species and have definite territories they still desire a certain amount of companionship. In a grove of underbrush and box-elder trees two nests were found in box-elder saplings fourteen yards apart. In an open area three other nests, one in a wolfberry, one in a wild currant, and the other in a box-elder sapling, formed a triangle nineteen by twenty by thirty-three yards. There appeared to be many other nesting sites in these areas from which the birds could choose. Apparently they may desire companionship to some extent and still maintain a certain yardage for territorial claims.

EGG LAYING

From observations on nest building it appeared that egg laying began on the day following or possibly on the same day that the nest was completed. Since the last stages in the nest building were so slow it was difficult to tell when the last few strands of nest material were added so that the nest could be called a finished product. For instance, it was thought that the nest described above, which was closely observed during building, was finished on the fourth morning, but not until that evening was it realized that a small amount of material had been added during the day. Therefore a still smaller amount of material might have been added on the fifth morning just before egg laying, but this does not seem probable. From these observations and from the fact that in two other nests the first eggs were laid on the fifth day, it seems probable that the first egg is laid the day after completion of the nest. At least, this seems to be true for the three nests observed.

In none of the daily trips was any evidence found that two eggs were laid on the same day. In 1939, on four different days, two trips were made to each nest, one in the morning and one in the late afternoon, and in no case was an egg found to have been laid in the afternoon.

Normally there were three to five eggs per nest. This statement does not include those cases in which a nest was deserted or destroyed before the apparent completion of egg laying or where the presence of Cowbirds' eggs caused burial of warblers' eggs. Some of the nests when first found contained young, but by considering each young as

representing an egg and by including the buried warbler eggs as well as the eggs in the destroyed or deserted nests, the number of eggs laid were as follows: one nest, with six eggs; thirteen, with five eggs; eighteen, with four eggs; seven, with three eggs; and two, with two eggs. The average was four eggs per nest. Chapman (1907) and Pearson (1936) have also recorded nests with six eggs.

In four nests (39, 42, 43, 47), eggs were laid at a rate of one egg per day until a clutch of four was completed. Two other nests (4, 23) with three eggs each, had an interval of two days between the laying of the second and third eggs. Of two nests (18, 44) which were destroyed, one (18) had intervals of one day each between the laying of the first, second, and third eggs, and the other (44) had an interval of one day between the first and second eggs. Egg laying had progressed to such an extent in the remaining nests when first discovered that it was not possible to check the intervals.

In color, the eggs ranged from grayish to bluish white, and were more or less thickly speckled with brownish shades. The speckling in many cases was denser at the larger end and frequently formed a wreath. In some cases the first, the last, or the intermediate eggs of a nest were slightly more speckled or wreathed, so no definite relationship was observed which showed a change in speckling or forming of wreaths on the first or last eggs of a nest.

The length of seventy eggs was found to vary from 20.5 to 15.5 mm. The arithmetical mean was 17.32 mm., with a probable error of ± 0.08 mm. Width of eggs in the region of the greatest diameter ranged from 16.0 to 12.3 mm., with an arithmetical mean of 13.29 mm. and a probable error of ± 0.06 mm. Chapman (1920) gives egg dimensions as 0.70 x 0.50 inches (17.78 x 12.70 mm.).

There was only one nest (33) which had all eggs of the same dimensions. It contained three eggs which were 17.8 x 13.5 mm. One nest (37) of five eggs contained two which were 16.2 x 12.8 mm.; and one each which were 15.8 x 12.6, 16.1 x 12.8, and 16.5 x 12.8 mm. A nest (47) of four eggs had two eggs 18.0 x 13.8 mm.; the other two, 18.1 x 13.4 and 17.8 x 13.8 mm. One nest (34) which held six eggs contained an abnormally large egg which was 20.5 x 16.0 mm. This egg weighed only 0.5 gm. and was the largest one found. Upon examination it was found to contain nothing but a small amount of yolk. Other eggs of this nest were: 16.8 x 13.0, 17.0 x 12.5, 17.0 x 13.0, 17.5 x 13.0, and 18.0 x 12.8 mm.

Table 1 shows the linear and weight relations of the eggs of nests (39, 42, 43, 47) which contained four eggs each, laid on successive

days. Gentian violet was used to mark the eggs. A dot on a side denoted the first egg; a dot on the large end, the second; a dot on the small end, the third; and a dot on both the large and the small end, the fourth. These data indicate that the weight of eggs increases from the first to last laid and the only exception is the fourth egg of nest number 47. This egg weighed slightly less than the third-laid egg although they were of the same dimensions. All eggs of nests

TABLE 1

| Nest number | Day laid | Dimensions | Weight of egg (grams) | Before incubation | |
|-------------|----------|-------------|-----------------------|------------------------------|--------------------------------|
| | | | | Total weight of eggs (grams) | Average weight per egg (grams) |
| 39 | 1 | 16.0 x 13.0 | 1.275 | 5.20 | 1.30 |
| | 2 | 16.8 x 13.0 | — | | |
| | 3 | 17.2 x 12.9 | — | | |
| | 4 | 17.7 x 12.8 | 1.35 | | |
| 42 | 1 | 17.1 x 13.5 | 1.50 | 6.30 | 1.575 |
| | 2 | 17.3 x 13.3 | — | | |
| | 3 | 17.5 x 13.8 | — | | |
| | 4 | 18.0 x 14.0 | 1.75 | | |
| 43 | 1 | 16.8 x 13.0 | 1.40 | 6.10 | 1.525 |
| | 2 | 16.5 x 13.1 | 1.45 | | |
| | 3 | 17.2 x 13.3 | 1.60 | | |
| | 4 | 17.8 x 13.1 | 1.65 | | |
| 47 | 1 | 18.1 x 13.4 | 1.525 | 6.40 | 1.60 |
| | 2 | 17.8 x 13.8 | 1.60 | | |
| | 3 | 18.0 x 13.8 | 1.65 | | |
| | 4 | 18.0 x 13.8 | 1.625 | | |

numbers 39 and 42 were not weighed, but because of their relative increase in linear measurements it could be assumed that there was also an increase in weight. Measurements on these nests also show that as an egg becomes longer it does not necessarily become wider. This was noted in each of the four nests. Therefore it is possible that rapid egg laying or nests of many eggs may show a greater variation in size. This was noted in the nest (34) of six eggs which contained the large abnormal egg, but the interval of egg laying in this nest was not known. In the nest (33) with three eggs of identical size there was an interval of two days between laying of the second

and third eggs, but information was lacking on the interval between the first and second eggs.

The clutch of eggs in three nests (42, 43, 47) was weighed daily after the laying of the last egg until hatching. It was found that they decreased in weight but at no definite rate each day, for on some days there was no weight difference detected. Table 2 shows that the percentage of weight lost from the time of the last-laid egg until hatching was very nearly the same for the eggs of all three nests.

TABLE 2

| Nest number | Number of eggs | Average weight per egg (grams) | | % of weight lost per egg |
|-------------|----------------|--------------------------------|----------------------|--------------------------|
| | | After last laid egg | Just before hatching | |
| 42 | 4 | 1.575 | 1.413 | 10.22 |
| 43 | 4 | 1.525 | 1.350 | 11.49 |
| 47 | 4 | 1.600 | 1.425 | 10.94 |

INCUBATION

Brooding of eggs was performed entirely by the female. Every visit to the nests would flush the female or find her in the vicinity of the nest, while it would be some time before the male would appear from a distance. In one case the male did not appear for an interval of half an hour. However, the male was in sight and was attentive during the feeding of the young. The male birds used trees or bushes as watch-towers from which they would alight in the case of approaching enemies or of signals from the female. On three different nights three nests were visited and the female was seen brooding, at times with her head tucked 'under' her wing. A blind was also erected at one nest (47) before the young hatched, and it was found that at varying intervals throughout the day, for four days before hatching, the female did all the brooding. She would leave the nest at intervals of about fifteen to twenty minutes, presumably for feeding. The writer had the pleasure of seeing the male feed the female while brooding eggs, but this was never seen while she brooded the young.

By carefully watching the marked eggs as well as eggs of other nests, it was found that they began hatching within a range of eight to ten days from the time that the last egg was laid. The average was nine days. There was an average of eleven days from the time the last egg was laid until the last young hatched, with a range of eleven to twelve days. In three nests (4, 23, 33), containing three

eggs each, there was an interval of eleven days from the time the last egg was laid until the last young hatched. The interval of hatching for the first young of one nest (33) was eight days; for the other nests (4, 23), nine days. The interval of hatching for the second young in one nest (4) was ten days; for the other nests (23, 33), nine days. This may mean that some brooding is done before all eggs are laid. An interfering factor could be due to one nest (33) having two eggs when found and three days elapsed before the third egg was laid. In the other nests (4, 23) there was an interval of two days between laying of the second and third egg. Of the four nests (39, 42, 43, 47) of Table 1 containing the marked eggs which were laid in successive days, the one nest (39) was dispossessed (cause unknown) of the first three eggs laid, a few days before hatching. The fourth egg hatched in eleven and one-half days from the time it was laid. In another nest (42) the first egg became addled but the second and third hatched in ten days from the time of laying of the last egg; the last-laid egg hatched in twelve days. In another nest (43) the first and second eggs hatched in ten days from the laying of the last egg; the third and the fourth, in eleven and one-half days. In the remaining nest (47), the first and second eggs hatched in nine days from the laying of the last egg; the third, in nine and one-half days; and the fourth, in eleven days. After the laying of the first egg in each of two nests (42, 43) there was a cold rain and at 10:00 A. M. the females were not on the nests but let the eggs become cold. Even considering this, the above variations in the incubation period for the first- and last-laid eggs may still indicate that brooding may start before all eggs are laid.

In the above calculations on incubation it was assumed that all eggs were laid during the hours of 3:00 A. M. to 8:00 A. M.; and as mentioned before, there were no indications of egg laying in the afternoon. Out of one hundred and nineteen hatched eggs, nine were hatched in the afternoon. One hundred and ten were hatched at night or in the early morning.

FEEDING

The feeding of young was shared by both adult birds. After the young hatched the female was always present in the nest vicinity, and was usually seen in the same clump of bushes where the nest was located, or in nearby foliage. While she was gleaning food from the lower branches, the male would flit along the top branches, seemingly with less vigor, in a search for food. Although he searched for food and would make many trips to the nest, his main duty seemed to

consist of a constant chirping about the nest site while his mate searched diligently.

At one nest (40) the male took the more active part in feeding. This nest was located in a box-elder sapling in a grove of underbrush and box-elder trees. A blind was erected at this nest two days before the eggs began to hatch. The nest had one buried Cowbird's egg and a second story contained four warbler's eggs, but two of the latter were addled. The morning the first young hatched, the blind was moved within two and one-half feet of the nest. On the following morning two young were present. Daily observations were made mainly at morning, noon, and late evening until the fledglings left the nest. On the morning that the second young was hatched there was a cold but light and intermittent rain which lasted until the middle of the afternoon. On this day, as on the previous day when the first young was hatched, the male would bring food to the nest and place it in the gaping mouth of the female who would dispense it to the young. At times the male would do the feeding, provided that the female was in a standing position which enabled him to see the young. The female would leave the nest about every ten to twelve minutes, even at times when there was a sprinkle of rain. She would usually return in about five minutes but not always with food.

After the third day of hatching, the male would give a signal each time he came to the nest, upon which the female would leave. From this time on throughout the entire nesting period of the young, the female left the nest at ten- to twelve-minute intervals even if the male did not bring food for the young. She would return at about this ten- to twelve-minute interval and usually without food. Feeding was most pronounced in early morning and late afternoon. On one day, feeding continued until 8:05 P. M., and just before this the male brought food three times at two-minute intervals.

At 8:00 A. M., on the day the first young was ten days old, it preened itself and at times stood in the nest stretching its wings. Both parents were now feeding it frequently in preference to the younger one. After fifteen minutes of observation the fledgling climbed onto the rim of the nest and stood there stretching. It remained on the rim about five minutes, when the female came with food. Instead of giving the food to the fledgling, she would call and flit from limb to limb in the sapling. Within ten minutes she had coaxed the young to the top branches of a nearby sapling, where she fed it. After this she was not seen feeding the young that remained in the nest.

The second young left at 5:00 P. M. of the same day, at a time

when it could be considered nine and one-half days old, after first going through exercises like the first-hatched young. It left the nest after being fed by the male and while the male was still standing beside the nest; the male did not seem to coax the youngster, but merely stood there and watched.

Since the female remained on the nest for the first two days while the male brought food, she was usually in a position to catch easily the excreta sacs which she swallowed. As she was in a standing position in the nest while feeding the young, the male would watch carefully for a chance to seize the excreta sac which he would then devour; this seemed to be his reward for bringing food. On the day when the first-hatched young was eight days old, the male continued to devour the excreta sacs provided that they were small, but large ones were carried away.

At another nest (47) where a blind was erected in order to watch the brooding of eggs, the greater part of the feeding of the four young was carried on by the female. The reason the male may have done the larger part of feeding at the other nest (40) could have been due to the female trying to brood the two addled eggs. These addled eggs were still in the nest until sometime during the early hours of the eighth day after hatching of the first young.

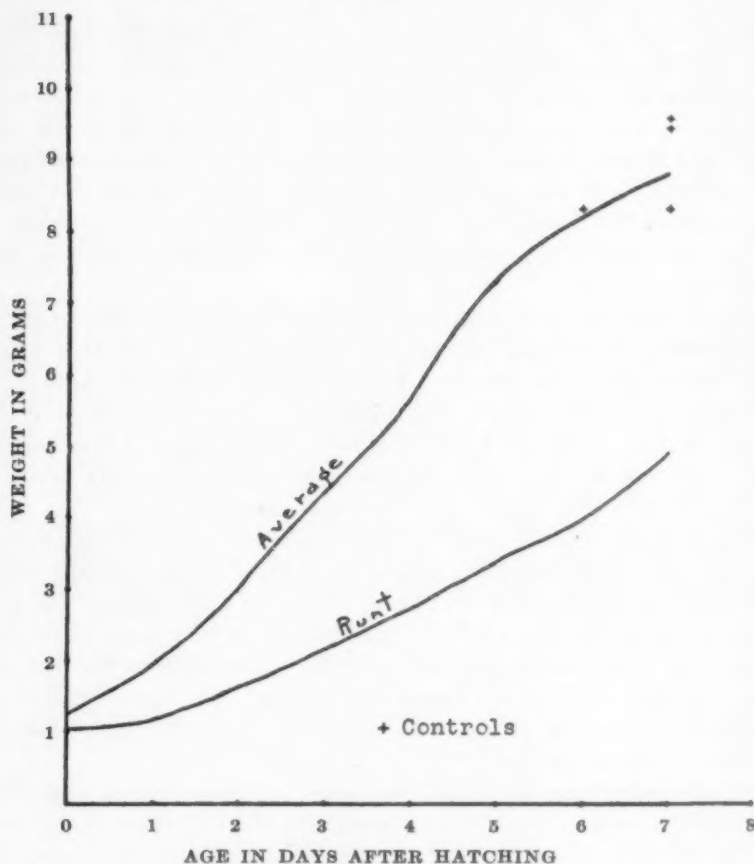
The females at both nests usually faced the most exposed side of the nest site while brooding eggs and young. Then, too, the males and females usually took a definite course in approaching the nest. Both males would sing while in the saplings in which the nests were located or while standing on the nest rim. The male at the one nest (40) sang after feeding the young and once he sang three times while standing on the rim of the nest. Mousley (1926) has also observed the male sing on the nest.

Never throughout the entire brooding of young was a male seen feeding the female. At the one nest (40) she did eat a large moth which the male brought, after she tried to feed it to the young but to no avail. The males would usually bring large mouthfuls of a mixture of foods, as insects and larvae, while the female usually brought smaller feedings which appeared to be one kind of food. Feeding of young warblers has been fully discussed by Bigglestone (1913).

WEIGHING

The project of weighing the young birds, as well as checking the nesting period, involved marking first- and last-hatched warblers in the nests. This marking was done on the crown or the back with

gentian violet. In order to avoid fading, the dye was replaced at intervals but this was seldom necessary. The originally dyed down usually projected above the juvenal plumage, especially on the crown, until the end of the nesting period.

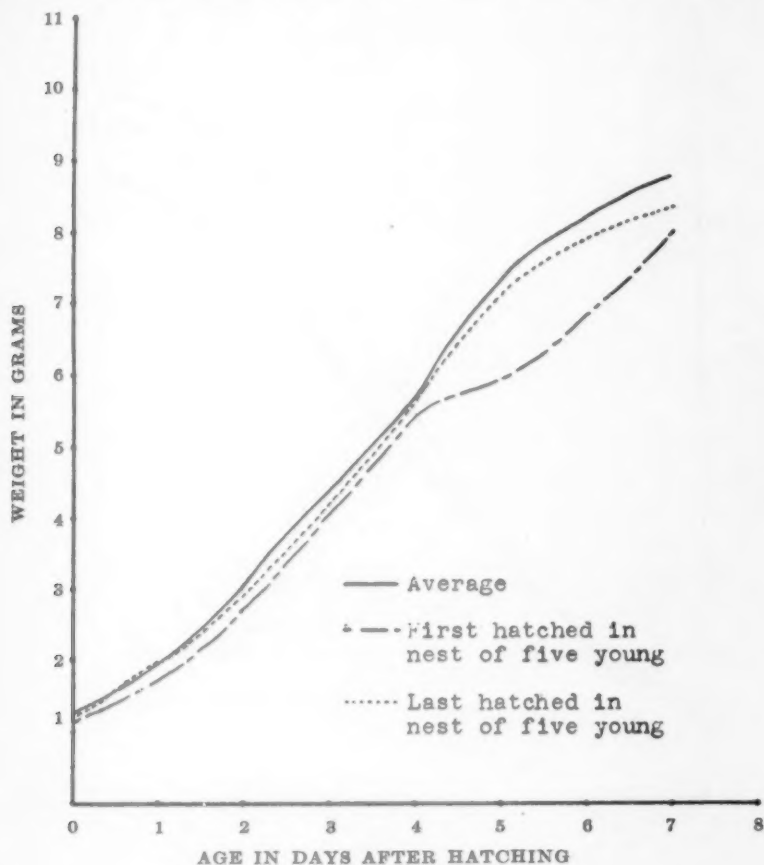


GRAPH 1

Thirty-three young in fourteen different nests were weighed. The weighing took place between 9:00 A. M. and 11:30 A. M. Fifteen were weighed on the morning of hatching, and of these, six were weighed each morning until they were seven days old. They were not weighed after seven days of age due to the possibility that they might leave the nest prematurely if disturbed. If during the first seven days of age a young bird seemed excited after being placed back in the nest after weighing, it could be calmed by covering the nest

with the hand so as to darken the interior. Soon the bird would settle into a comfortable position.

Almost immediately after removal of a young from the nest it would void its excreta, which helped to diminish the error in weighing

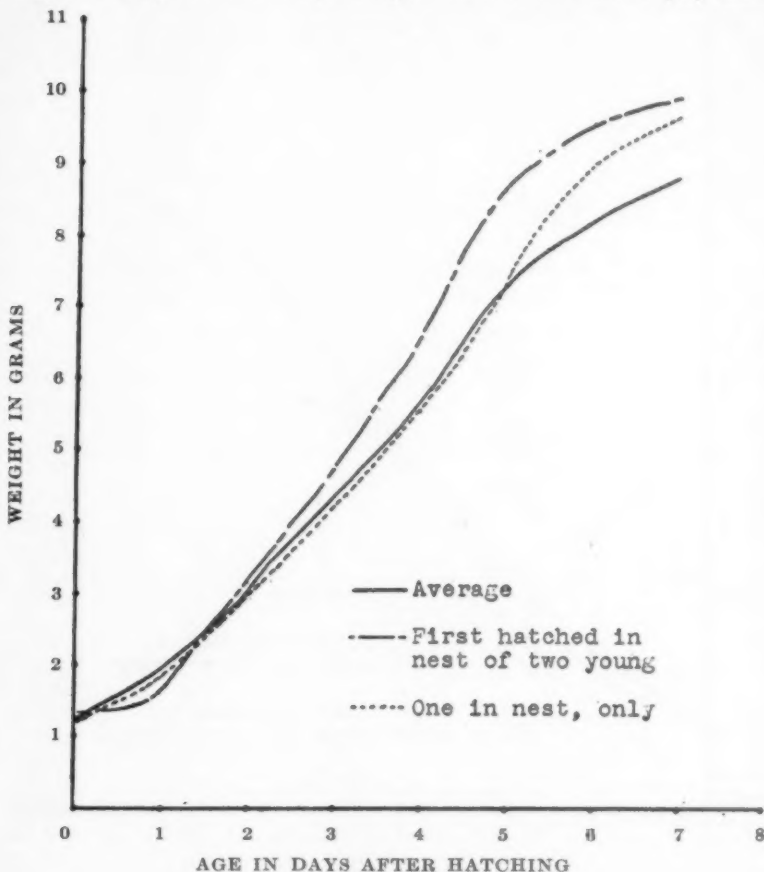


GRAPH 2

the small, young bird. Since the young birds voided their excreta sacs after handling, this does not seem necessarily due to an intensification of feeding as some have suggested. Nor would the voiding of excreta be due to a direct stimulus from feeding.

From 109 weighings the average rate of growth is represented in Graph 1. The young averaged, when hatched, 1.27 gms.; at one day old, 1.87; at two days old, 2.95; at three days old, 4.36; at four days old, 5.57; at five days old, 7.26; at six days old, 8.20; at seven days old, 8.78.

Two nests of two young each were used as controls and the young were weighed only once. In one nest (22) a seven-day-old young, the first hatched, weighed 8.30 gms. and its mate, the second hatched, weighed 8.30 gms. at six days of age. In the other nest (35) the bird

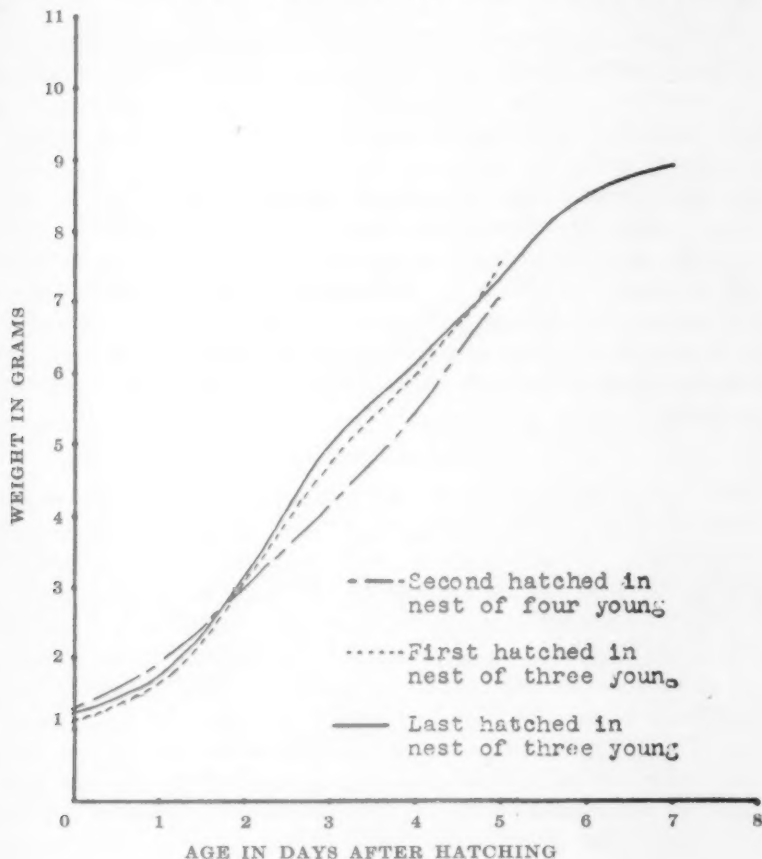


GRAPH 3

first hatched weighed 9.50 gms. at seven days of age, and its mate, the second hatched, weighed 9.40 gms. at seven days of age (Graph 1). Comparison of these controls with average weights of the young indicates that careful handling does not impair their rate of growth.

In a nest (37) of five young the first-hatched attained a weight of 8.00 gms. in seven days. It was a few hours older than two of its mates and one day older than the two others. In another nest (30) of five young the last-hatched attained a weight of 8.33 gms. in seven

days. This one was two days younger than two of its mates and one day younger than the other two. Graph 2 represents a comparison of these two nests with the average curve. In a nest (34) which contained only one young (Graph 3), the weight at seven days



GRAPH 4

of age was 9.65 gms.; while in a nest (40) of two young (Graph 3), at seven days of age, the first-hatched weighed 9.90 gms. and its mate weighed 9.15 gms. at six days of age. From these weight relations it appears that the number of young in a nest does not necessarily affect the rate of growth to any great extent. It was observed at the end of seven days that individuals in nests containing only one or two young gained weight but slightly faster than some individuals in nests of three or four young, but weighed slightly more than those in nests

containing five young (Graph 4). In nests of one or two young it appears that there is enough food brought to satisfy the young and therefore the instinct of feeding a gaping mouth may no longer be aroused in the adult, while the nests of many young cause the adult birds to work harder.

One young, which was called 'Runt,' was a very interesting case. The weight and dimensions of the egg from which this young hatched were not known. This young weighed 1.03 gms. just after emerging from the shell on a cold and rainy morning. It was the last hatched in a nest (24) of four, being one day younger than two of its mates and a few hours younger than the third mate. Besides being under normal weight, 'Runt' may have contracted a cold caused by weighing on the morning of hatching for the gain in weight each day was small as shown in Graph 1. Regardless of this young's handicaps, it left the nest the morning it was ten days old. The runt was weighed shortly after leaving the nest and tipped the scales at 7.20 gms. The weighings of this bird were not included in figuring the average rate of growth.

YOUNG WARBLERS

The Yellow Warblers are hatched naked except for a scanty amount of down and are an interesting sight with their large bulging eyes and abdomen. It was observed that the eyes were commencing to open on the third day after hatching. By the fifth day the young can completely open their eyes, but in many cases would immediately close them when the nest was approached. At this age they would also duck down into the nest as if trying to hide. A slight tapping on the nests would cause a rapid outstretching of necks with open mouths. Signs of the pangs of hunger appeared greatest in the smallest young. This young bird seemed justified in its signs of hunger for it was usually crowded down in the nest by its larger mates, but since the youngest of many nests gained weight at the same rate as others of a nest it is difficult to explain why the youngest would always act so hungrily. It is possible that the older young could distinguish the adult birds from a mere tapping, while the younger had not reached this stage of distinction.

The young warblers normally remained in the nest for a period of eight to ten days, with an average of nine and one-half days. This nesting period was independent of the number of young present in a single nest. Crowded nests of five appeared more restless, which may have caused them to leave the nest sooner. In two nests of five young each, all the young birds left in eight to nine days, while in a

nest with only two, located in the shade of a grove, they remained for eleven days. Other nests of only two young were deserted in eight to ten and one-half days. Young left the nests containing three within nine to ten days. Young in nests of four left in nine to eleven days. In the nest which contained only one young, the fledgling left in ten days. The oldest fledgling was one of the first to leave in all nests observed. In seven instances, a nest mate a day younger than the oldest bird left on the same day as the older.

At the end of the nesting period, a bird's first adventure was to perch on a small branch about six inches from the nest. On many visits a young bird which seemed to have just left the nest was found in the same position, which was in a spot protected from the sun. If the nest were in a position where the direct rays of the sun would strike it the young were very restless.

After all the young left a nest, the parent birds could be found feeding them in the immediate vicinity of the nest for a period of about three days. After this time the birds became more dispersed from the nesting site, but could still be found in the vicinity for a week or ten days.

After observing the used and also the deserted nests, it was found that in many cases the nests would be disordered as if an intruder had been looking for hidden eggs. This occurs from one to ten days after the nest has been abandoned. On later observations, six nests had been completely torn apart with debris from the nests hanging from the small twigs or lying upon the ground. There was no occasion for observing evidence of a second brood.

Tables 3, 4, and 5 represent the mortality rate of the Yellow Warbler, which is the calmest in disposition of the entire warbler family. Of the 168 eggs in forty-one nests, 119 eggs, representing 70.83%, hatched. Thirty-four eggs, representing 20.24%, disappeared due to wind, abandonment of nest, and unknown causes. Fifteen eggs, representing 8.93%, were addled, two of which were buried with a Cowbird's egg. Of the 119 nestlings, twenty-eight disappeared. This represents 16.66% of all eggs laid. Four of them were seen dead in the nests. The others disappeared from unknown causes. Therefore a total of 91 fledglings, representing 54.17% of the original 168 eggs, left the nest.

It would be interesting to carry on a weighing project of the adult warblers. This could easily be done by slowly building a wire trap around the nest. Then the female could be weighed during the different stages of brooding and at the departure of the fledglings. The male could possibly be weighed at the beginning and at the end of

TABLE 3

| Eggs | Hatched | | Failed to hatch | | | |
|------|---------|-------|-----------------|-------|--------|------|
| | | | Disappeared | | Added | |
| | Number | % | Number | % | Number | % |
| 168 | 119 | 70.83 | 34 | 20.24 | 15 | 8.93 |

TABLE 4

| Nestlings | Disappeared | | Left nest as fledglings | |
|-----------|-------------|-------|-------------------------|-------|
| | Number | % | Number | % |
| 119 | 28 | 23.53 | 91 | 76.47 |

TABLE 5

Hatched:

| | |
|-----------------------------|--------------|
| Survived as fledglings..... | 54.17% |
| Missing fledglings..... | 16.66% |
| | <hr/> 70.83% |

Not hatched:

| | |
|------------------|---------------|
| Disappeared..... | 20.24% |
| Added..... | 8.93% |
| | <hr/> 29.17% |
| | <hr/> 100.00% |

the feeding period. By making these weighings it would be possible to note what loss of weight, if any, is encountered during the stages of nest life. Also, in this way, a check could be made to see what difference in loss of weight, if any, is encountered by adults rearing a large or a small brood. Baldwin and Kendeigh (1938) have given the average weight of two adults as 9.6 gms., for the month of May.

The writer wishes to express his appreciation to Dr. Robert L. King, of the State University of Iowa, for much help and valuable suggestions in carrying on this work. (All nests numbered 1-20 were observed in 1938. All nests numbered 21-48 were observed in 1939.)

SUMMARY

Forty-one nests of the Yellow Warbler were studied.

Nest building is carried on for four days.

Not more than one egg is laid per day. Last-laid eggs weigh more than first-laid eggs.

Seventy eggs were weighed and the linear measurements taken. Eggs averaged 17.32 mm. in length, and 13.29 mm. at greatest width. The average weight per egg at the end of egg laying was 1.57 gms., and the average weight per egg just before hatching was 1.40 gms.

Eggs decrease in weight during incubation.

All brooding is performed by the female.

The average incubation period is eleven days.

Males sing on the nest often, after having fed the young.

The young averaged, when hatched, 1.27 gms.; at one day old, 1.87 gms.; at two days old, 2.95 gms.; at three days old, 4.36 gms.; at four days old, 5.57 gms.; at five days old, 7.26 gms.; at six days old, 8.20 gms.; and at seven days old, 8.78 gms.

Fledglings in nests containing five young leave the nest sooner than those of nests having one or two young.

The last hatched of any nest may gain weight as rapidly as the first hatched.

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A COMPARATIVE STUDY
OF THE BREEDING BIRD POPULATION
OF THE SHENANDOAH MOUNTAINS, VIRGINIA

BY ROBERT E. STEWART

WHILE working on habitat studies of the Ruffed Grouse (*Bonasa umbellus*) in the George Washington National Forest during the late spring and early summer of 1941, the author found it possible to carry out a supplemental study on the relative abundance of the breeding birds of the area. Since considerable time was spent in traversing certain sections of the forest in search of Ruffed Grouse broods, an unusual opportunity was afforded to make a general comparative census of the species of birds found therein.

The original intention was to obtain data on the relative abundance of the birds found in the various types of habitat within the area. However, it was soon found to be impracticable to carry out such a study with any degree of accuracy, since the various forest types were found to be overlapping and intermixed to such an extent that it was not possible to segregate them into separate areas except in a very general way. Consequently, it was necessary to limit the objective to a study of the comparative abundance of the birds found in the general region.

The area selected for this study was sufficiently restricted in size so that it was possible to cover it fairly well during the course of one month. This area comprises approximately 135 square miles and is located in the Shenandoah Mountains, Augusta and Highland counties, Virginia. It is bounded by Narrow-back Ridge on the east, by 'Briary Branch-Reddish Knob Road' and the Virginia-West Virginia boundary on the north, by 'Cow Pasture River Valley Road' on the west, and by U. S. Highway No. 250 and an imaginary line running from Lebanon to Stokesville on the south.

In order to be more certain that the study was restricted to the breeding birds of the region, only observations made during the month of June were included in the data. All birds found in the region during this month were believed to be breeding species, with the possible exception of the Redstart (*Setophaga ruticilla*). Only one individual of this species was recorded; and since that was on June 1, this bird may have been a late migrant.

The census procedure was simple. Whenever it was possible to devote full attention to the birds in the immediate surroundings, all individuals (adults or full-fledged young of adult size) that were either seen or heard and that could be positively identified were re-

corded. Special effort was made to walk at a fairly constant pace and to cover the various habitats in such a manner that the amount of time spent in each was as nearly as possible proportional to the relative extent of each within the region. The time consumed in conducting this census aggregated exactly 48 hours. The resulting totals do not by any means represent all the individuals observed during the entire period of stay in the area, but only those recorded during the time that a regular census was being taken.

National Forest land, with altitudes ranging up to 4410 feet, comprises more than 95 per cent of the study area. With the exception of a few isolated, brushy, old clearings, this land is overgrown with timber of various kinds, mostly second growth. The census method used in this study seemed to work very well on this type of land.

On the outer margins of the National Forest are found small private holdings of farm lands comprising a heterogeneous mixture of farm yards, small pastures, and fields. Because of their small size and patchwork composition, the census method employed was not found to be practicable for these farms. Inasmuch as several species of breeding birds found on them were not observed elsewhere within the study area, they are listed separately below, without any attempt to indicate their relative abundance:

- Quail (*Colinus virginianus*)
- Killdeer (*Oxyechus vociferus*)
- Kingbird (*Tyrannus tyrannus*)
- Barn Swallow (*Hirundo erythrogaster*)
- Cliff Swallow (*Petrochelidon albifrons*)
- House Wren (*Troglodytes aëdon*)
- Bluebird (*Sialia sialis*)
- Starling (*Sturnus vulgaris*)
- Yellow Warbler (*Dendroica aestiva*)
- English Sparrow (*Passer domesticus*)
- Meadowlark (*Sturnella magna*)
- Red-winged Blackbird (*Agelaius phoeniceus*)
- Grasshopper Sparrow (*Ammodramus savannarum*)
- Vesper Sparrow (*Pooecetes gramineus*)

The Rough-winged Swallow (*Stelgidopteryx ruficollis*) should be mentioned here, as it was observed only at the small lake formed by the Staunton dam, a type of habitat that is foreign to this mountainous region.

Other birds observed that would not be adequately represented in the comparative type of census are those that are inactive during the greater part of the daylight hours. The species falling into this category are: Barred Owl (*Strix varia*), Screech Owl (*Otus asio*), Whip-

poor-will (*Antrostomus vociferus*), and the Nighthawk (*Chordeiles minor*). Since no definite recorded data were obtained on their relative abundance, the following classification is derived from general observations only: Barred Owl, common; Screech Owl, uncommon; Whip-poor-will, abundant; and Nighthawk, rare.

The data pertinent to the relative abundance of the species of birds observed within the study area, with the exception of those that have already been listed, are presented in the following tables. The frequency classes depicting relative abundance used in these tables are listed as follows: abundant, plentiful, common, occasional, uncommon, and rare. The average number of individuals observed and heard, 31 per species, is used as the median point in the class definitions. The range of figures below the median figure (1-31) is divided into three classes that are approximately equal in size: rare, 1-10; uncommon, 11-20; and occasional, 21-31. The range of figures above the median point (32-275) is also divided into three classes that are about equal in size. These are defined as follows: common, 32-113; plentiful, 114-194; and abundant, 195-275. The data relating to the comparative populations of the larger taxonomic groups are also summarized in these tables, so as to indicate the size ratios and prevalence of each within the area.

TABLE 1
BIRDS RECORDED, LISTED BY SPECIES

| Name | No. seen | No. heard but not seen | Total | Per- centage | Relative abundance |
|---|-------------|------------------------------|-------|-----------------|-----------------------|
| Turkey Vulture (<i>Cathartes aura</i>) | 18 | — | 18 | 0.83 | Uncommon |
| Black Vulture (<i>Coragyps atratus</i>) | 1 | — | 1 | 0.05 | Rare |
| Cooper's Hawk (<i>Accipiter cooperi</i>) | 1 | — | 1 | 0.05 | Rare |
| Red-tailed Hawk (<i>Buteo borealis</i>) | 4 | 1 | 5 | 0.23 | Rare |
| Red-shouldered Hawk (<i>Buteo lineatus</i>) | 1 | — | 1 | 0.05 | Rare |
| Broad-winged Hawk (<i>Buteo platypterus</i>) | 2 | — | 2 | 0.09 | Rare |
| Ruffed Grouse (<i>Bonasa umbellus</i>) | 32 | 2 | 34 | 1.57 | Common |
| Wild Turkey (<i>Meleagris gallopavo</i>) | 2 | — | 2 | 0.09 | Rare |
| Woodcock (<i>Philohela minor</i>) | 10 | — | 10 | 0.46 | Rare |
| Spotted Sandpiper (<i>Actitis macularia</i>) | 1 | — | 1 | 0.05 | Rare |
| Mourning Dove (<i>Zenaidura macroura</i>) | 3 | — | 3 | 0.14 | Rare |
| Yellow-billed Cuckoo (<i>Coccyzus americanus</i>) | 3 | 12 | 15 | 0.69 | Uncommon |
| Black-billed Cuckoo (<i>Coccyzus erythrophthalmus</i>) | 2 | 1 | 3 | 0.14 | Rare |
| Chimney Swift (<i>Chaetura pelagica</i>) | 9 | — | 9 | 0.42 | Rare |
| Ruby-throated Hummingbird (<i>Archilochus colubris</i>) | 5 | — | 5 | 0.23 | Rare |
| Belted Kingfisher (<i>Megascyle alcyon</i>) | 1 | — | 1 | 0.05 | Rare |
| Flicker (<i>Colaptes auratus</i>) | 8 | 8 | 16 | 0.74 | Uncommon |
| Pileated Woodpecker (<i>Ceophloeus pileatus</i>) | 3 | 23 | 26 | 1.20 | Occasional |
| Yellow-bellied Sapsucker (<i>Sphyrapicus varius</i>) | 7 | — | 7 | 0.32 | Rare |
| Hairy Woodpecker (<i>Dryobates villosus</i>) | 8 | — | 8 | 0.37 | Rare |

TABLE 1—(Continued)

| Name | No. seen | No. heard but not seen | Total | Per- centage | Relative abundance |
|--|-------------|------------------------------|-------|-----------------|-----------------------|
| Downy Woodpecker (<i>Dryobates pubescens</i>) | 5 | — | 5 | 0.23 | Rare |
| Crested Flycatcher (<i>Myiarchus crinitus</i>) | 3 | 19 | 22 | 1.02 | Occasional |
| Phoebe (<i>Sayornis phoebe</i>) | 6 | 7 | 13 | 0.60 | Uncommon |
| Acadian Flycatcher (<i>Empidonax virescens</i>) | 4 | 26 | 30 | 1.39 | Occasional |
| Least Flycatcher (<i>Empidonax minimus</i>) | 2 | 1 | 3 | 0.14 | Rare |
| Wood Pewee (<i>Myiochanes virens</i>) | 5 | 61 | 66 | 3.06 | Common |
| Blue Jay (<i>Cyanocitta cristata</i>) | 7 | 13 | 20 | 0.93 | Uncommon |
| Raven (<i>Corvus corax</i>) | 6 | — | 6 | 0.28 | Rare |
| Crow (<i>Corvus brachyrhynchos</i>) | 18 | 36 | 54 | 2.50 | Common |
| Chickadee (<i>Parus sp.</i>) | 24 | 27 | 51 | 2.36 | Common |
| Tufted Titmouse (<i>Baeolophus bicolor</i>) | 2 | 23 | 25 | 1.16 | Occasional |
| White-breasted Nuthatch (<i>Sitta carolinensis</i>) | 6 | 3 | 9 | 0.42 | Rare |
| Carolina Wren (<i>Thryothorus ludovicianus</i>) | 7 | 6 | 13 | 0.60 | Uncommon |
| Catbird (<i>Dumetella carolinensis</i>) | 4 | 3 | 7 | 0.32 | Rare |
| Brown Thrasher (<i>Toxostoma rufum</i>) | 11 | 1 | 12 | 0.56 | Uncommon |
| Robin (<i>Turdus migratorius</i>) | 10 | 5 | 15 | 0.69 | Uncommon |
| Wood Thrush (<i>Hylocichla mustelina</i>) | 6 | 75 | 81 | 3.75 | Common |
| Veery (<i>Hylocichla fuscescens</i>) | 3 | 3 | 6 | 0.28 | Rare |
| Cedar Waxwing (<i>Bombicilla cedrorum</i>) | 23 | — | 23 | 1.07 | Occasional |
| Yellow-throated Vireo (<i>Vireo flavifrons</i>) | 2 | — | 2 | 0.09 | Rare |
| Mountain Vireo (<i>Vireo solitarius</i>) | 10 | 6 | 16 | 0.74 | Uncommon |
| Red-eyed Vireo (<i>Vireo olivaceus</i>) | 6 | 224 | 230 | 10.65 | Abundant |
| Black and White Warbler (<i>Mniotilta varia</i>) | 29 | 83 | 112 | 5.19 | Common |
| Worm-eating Warbler (<i>Helmitheros vermivorus</i>) | 7 | 15 | 22 | 1.02 | Occasional |
| Golden-winged Warbler (<i>Vermivora chrysoptera</i>) | 5 | 10 | 15 | 0.69 | Uncommon |
| Parula Warbler (<i>Compsothlypis americana</i>) | 4 | 96 | 100 | 4.63 | Common |
| Magnolia Warbler (<i>Dendroica magnolia</i>) | 5 | — | 5 | 0.23 | Rare |
| Cairns's Warbler (<i>Dendroica caerulescens</i>) | 17 | 51 | 68 | 3.15 | Common |
| Black-throated Green Warbler (<i>Dendroica virens</i>) | 8 | 50 | 58 | 2.69 | Common |
| Blackburnian Warbler (<i>Dendroica fusca</i>) | 7 | 57 | 64 | 2.96 | Common |
| Chestnut-sided Warbler (<i>Dendroica pensylvanica</i>) | 11 | 23 | 34 | 1.57 | Common |
| Prairie Warbler (<i>Dendroica discolor</i>) | 2 | 30 | 32 | 1.48 | Common |
| Oven-bird (<i>Seiurus aurocapillus</i>) | 34 | 241 | 275 | 12.73 | Abundant |
| Louisiana Water-thrush (<i>Seiurus motacilla</i>) | 12 | 28 | 40 | 1.85 | Common |
| Maryland Yellow-throat (<i>Geothlypis trichas</i>) | 5 | 13 | 18 | 0.83 | Uncommon |
| Yellow-breasted Chat (<i>Icteria virens</i>) | 3 | 7 | 10 | 0.46 | Rare |
| Hooded Warbler (<i>Wilsonia citrina</i>) | 4 | 46 | 50 | 2.31 | Common |
| Canada Warbler (<i>Wilsonia canadensis</i>) | 41 | 33 | 74 | 3.43 | Common |
| Redstart (<i>Setophaga ruticilla</i>) | 1 | — | 1 | 0.05 | Rare |
| Cowbird (<i>Molothrus ater</i>) | 3 | — | 3 | 0.14 | Rare |
| Scarlet Tanager (<i>Piranga erythromelas</i>) | 4 | 57 | 61 | 2.82 | Common |
| Cardinal (<i>Richmondia cardinalis</i>) | 6 | 6 | 12 | 0.56 | Uncommon |
| Rose-breasted Grosbeak (<i>Hedymeles ludovicianus</i>) | 4 | 1 | 5 | 0.23 | Rare |
| Indigo Bunting (<i>Passerina cyanea</i>) | 4 | 31 | 35 | 1.62 | Common |
| Goldfinch (<i>Spinus tristis</i>) | 9 | 6 | 15 | 0.69 | Uncommon |
| Towhee (<i>Pipilo erythrophthalmus</i>) | 24 | 97 | 121 | 5.60 | Plentiful |
| Junco (<i>Junco hyemalis</i>) | 15 | 5 | 20 | 0.93 | Uncommon |
| Chipping Sparrow (<i>Spizella passerina</i>) | 4 | 6 | 10 | 0.46 | Rare |
| Field Sparrow (<i>Spizella pusilla</i>) | 6 | 13 | 19 | 0.88 | Uncommon |
| Song Sparrow (<i>Melospiza melodia</i>) | 2 | 2 | 4 | 0.19 | Rare |
| | 567 | 1593 | 2160 | 100.00 | |

TABLE 2
BIRDS RECORDED, LISTED BY GENERA

| <i>Name</i> | <i>Total</i> | <i>Per-centage</i> | <i>Name</i> | <i>Total</i> | <i>Per-centage</i> |
|-------------|--------------|--------------------|---------------|--------------|--------------------|
| Cathartes | 18 | 0.83 | Thryothorus | 13 | 0.60 |
| Coragyps | 1 | 0.05 | Dumetella | 7 | 0.33 |
| Accipiter | 1 | 0.05 | Toxostoma | 12 | 0.56 |
| Buteo | 7 | 0.33 | Turdus | 15 | 0.70 |
| Bonasa | 34 | 1.57 | Hylocichla | 87 | 4.03 |
| Meleagris | 2 | 0.09 | Bombycilla | 23 | 1.06 |
| Philohela | 10 | 0.46 | Vireo | 248 | 11.48 |
| Actitis | 1 | 0.05 | Mniotilta | 112 | 5.19 |
| Zenaidura | 3 | 0.14 | Helmitheros | 22 | 1.02 |
| Coccyzus | 18 | 0.83 | Vermivora | 15 | 0.70 |
| Chaetura | 9 | 0.42 | Compsothlypis | 100 | 4.63 |
| Archilochus | 5 | 0.23 | Dendroica | 261 | 12.08 |
| Megascyle | 1 | 0.05 | Seiurus | 315 | 14.58 |
| Colaptes | 16 | 0.74 | Geothlypis | 18 | 0.83 |
| Ceophloeus | 26 | 1.20 | Icteria | 10 | 0.46 |
| Sphyrapicus | 7 | 0.33 | Wilsonia | 124 | 5.74 |
| Dryobates | 13 | 0.60 | Setophaga | 1 | 0.05 |
| Myiarchus | 22 | 1.02 | Molothrus | 3 | 0.14 |
| Sayornis | 13 | 0.60 | Piranga | 61 | 2.82 |
| Empidonax | 33 | 1.53 | Richmondia | 12 | 0.56 |
| Myiochanes | 66 | 3.06 | Hedymeles | 5 | 0.23 |
| Cyanocitta | 20 | 0.93 | Passerina | 35 | 1.62 |
| Corvus | 60 | 2.78 | Spinus | 15 | 0.70 |
| Penthestes | 51 | 2.36 | Pipilo | 121 | 5.60 |
| Baeolophus | 25 | 1.16 | Junco | 20 | 0.93 |
| Sitta | 9 | 0.42 | Spizella | 29 | 1.34 |
| | | | Melospiza | 4 | 0.19 |

TABLE 3
BIRDS RECORDED, LISTED BY FAMILIES

| <i>Name</i> | <i>Total</i> | <i>Per-centage</i> | <i>Name</i> | <i>Total</i> | <i>Per-centage</i> |
|----------------------------|--------------|--------------------|---------------------------------|--------------|--------------------|
| Cathartidae (Vultures) | 19 | 0.88 | Corvidae (Crows, Jays, etc.) | 80 | 3.70 |
| Accipitridae (Hawks) | 9 | 0.42 | Paridae (Titmice) | 76 | 3.52 |
| Tetraonidae (Grouse) | 34 | 1.57 | Sittidae (Nuthatches) | 9 | 0.42 |
| Meleagrididae (Turkeys) | 2 | 0.09 | Troglodytidae (Wrens) | 13 | 0.60 |
| Scolopacidae (Sandpipers) | 11 | 0.51 | Mimidae (Thrashers, etc.) | 19 | 0.88 |
| Columbidae (Doves) | 3 | 0.14 | Turdidae (Thrushes) | 102 | 4.72 |
| Cuculidae (Cuckoos) | 18 | 0.83 | Bombycillidae (Waxwings) | 23 | 1.06 |
| Micropodidae (Swifts) | 9 | 0.42 | Vireonidae (Vireos) | 248 | 11.48 |
| Trochilidae (Hummingbirds) | 5 | 0.23 | Compsothlypidae (Wood Warblers) | 978 | 45.28 |
| Alcedinidae (Kingfishers) | 1 | 0.05 | Icteridae (Blackbirds, etc.) | 3 | 0.14 |
| Picidae (Woodpeckers) | 62 | 2.87 | Thraupidae (Tanagers) | 61 | 2.83 |
| Tyrannidae (Flycatchers) | 134 | 6.20 | Fringillidae (Finches) | 241 | 11.16 |

Totals 2160—100%

TABLE 4
BIRDS RECORDED, LISTED BY ORDERS

| Name | Total | Percentage |
|---|-------|------------|
| Falconiformes (Hawks and Vultures) | 28 | 1.29 |
| Galliformes (Grouse and Turkeys) | 36 | 1.67 |
| Charadriiformes (Sandpipers, etc.) | 11 | 0.51 |
| Columbiformes (Doves) | 3 | 0.14 |
| Cuculiformes (Cuckoos) | 18 | 0.83 |
| Micropodiformes (Swifts and Hummingbirds) | 14 | 0.65 |
| Coraciiformes (Kingfishers) | 1 | 0.05 |
| Piciformes (Woodpeckers) | 62 | 2.87 |
| Passeriformes (Passerine or Perching Birds) | 1987 | 91.99 |
| Totals | 2160 | 100.00 |

The biotic communities within the forested area may be classified into at least four major habitats as follows: (1) old brushy clearings, (2) cove types, (3) lower slopes and ridges, and (4) higher slopes and ridges.

On the bottomland flats within a few of the larger coves are located scattered old brushy clearings, relics of a time when human beings found such places habitable. These clearings generally contain a few small areas of open turf that are surrounded by tangled growths of small trees, bushes, bramble (*Rubus* spp.), briar (*Smilax* spp.), and grape (*Vitis* spp.). Those birds that were found to be characteristic of these old clearings were: Robin, Cedar Waxwing, Golden-winged Warbler, Prairie Warbler, Yellow-breasted Chat, Cardinal, Indigo Bunting, Goldfinch, Chipping Sparrow, Field Sparrow, and Song Sparrow.

The cove forests are made up largely of white pine (*Pinus strobus*), hemlock (*Tsuga canadensis*), and various species of hardwoods, the most common of which are: white oak (*Quercus alba*), hickory (*Carya* spp.), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), tulip poplar (*Liriodendron tulipifera*), cherry birch (*Betula lenta*), basswood (*Tilia americana*), red oak (*Quercus borealis*), and cucumber tree (*Magnolia acuminata*). Certain species of birds were found regularly distributed throughout the coves, others were found predominantly in the lower portions, and still others were confined largely to the higher parts near the headwaters of streams. Differences in vegetation were due mainly to the more common occurrence of certain boreal types, such as yellow birch (*Betula lutea*), moosewood (*Acer pennsylvanicum*), and mountain maple (*Acer spicatum*) in the higher,

cooler sections of the coves. Species of birds which were regularly found throughout the coves were the Woodcock, Crested Flycatcher, Phoebe, Wood Pewee, White-breasted Nuthatch, Wood Thrush, Blackburnian Warbler, and Louisiana Water-thrush. Those which were found predominantly in the lower portions were the Yellow-billed Cuckoo, Acadian Flycatcher, Carolina Wren, Worm-eating Warbler, Parula Warbler, and Hooded Warbler. The species which were confined largely to the higher parts were the Yellow-bellied Sapsucker, Veery, Mountain Vireo, Magnolia Warbler, Cairns's Warbler, Black-throated Green Warbler, and Rose-breasted Grosbeak.

The lower slopes and ridges constitute a large percentage of the total area within the region and also represent the poorest type of habitat as far as numbers and species of birds are concerned. The canopy of this type is made up largely of chestnut oak (*Quercus montana*), scarlet oak (*Quercus coccinea*), and hard pine (*Pinus pungens*, *P. rigida*, and *P. virginiana*). No species of birds were found to be especially characteristic of this type.

The higher ridges and slopes are covered with isolated tracts of timber made up principally of red oak (*Quercus borealis*), cherry birch (*Betula lenta*), and chestnut (*Castanea dentata*) sprouts, with larger intervening expanses of brushland, the more common components of which are bear oak (*Quercus ilicifolia*), fetterbush (*Andromeda floribunda*), and mountain laurel (*Kalmia latifolia*). Scattered northern species such as mountain ash (*Sorbus americana*), pin cherry (*Prunus pennsylvanica*), and red raspberry (*Rubus idaeus*) were found on a few of the higher knobs; and small tracts of hard pine were also present. The birds that were more commonly found in this habitat than elsewhere were the Raven, Chestnut-sided Warbler, Maryland Yellowthroat, Towhee, and Carolina Junco.

The Canada Warbler was commonly found in the upper reaches of the coves as well as on the higher slopes and ridges. Other species not listed under the four major habitat types either occurred regularly over the entire region or were so rare as to make it unwise to reach any conclusions pertaining to their ecological distribution.

CONCLUSIONS

A total of 89 species of birds was found inhabiting the selected study area in the Shenandoah Mountains during the month of June, 1941. All are believed to be breeding species within the area, with the possible exception of the Redstart. Of these, fourteen were confined to the few outlying farms, one was found in a specialized type of habitat distinctly extraneous to the region, and four were nocturnal or crepus-

cular forms. The remaining 70 were diurnal species found on the forested lands. The use of a comparative type of census was not found to be satisfactory for those birds other than the diurnal species found on the forest.

The results of the comparative census, obtained from the identification and recording of 2160 individual birds, indicate that the breeding bird population within the forests of the region is composed of a mixture of southern (Austral) and northern (Boreal) species, with the southern species generally predominating. The three most abundant species, the Ovenbird, Red-eyed Vireo, and Towhee, comprised nearly 29 per cent of the total. The three most prevalent genera, *Seiurus*, *Dendroica*, and *Vireo*, constituted over 39 per cent of the total. More than 45 per cent of the birds were found to belong to one family, Compsothlypidae (Wood Warblers); while almost 92 per cent belonged to the order Passeriformes (passerine or perching birds).

Other points of interest brought out by this census are the representative percentages of the game birds to the total as well as the predator-prey ratios. The Ruffed Grouse and Wild Turkey, the two most important game birds in the region, made up slightly more than one and one-half per cent of the total. Other game birds of minor importance in this region, the Woodcock and Mourning Dove, constituted 0.6 per cent. The ratio of the diurnal birds of prey to the smaller non-predatory forms was about 1 : 259.

At least four major habitat types were recognized in the forested regions within the study area. Three of these were found to contain species of birds that were to a considerable extent peculiar to them. No attempt was made to conduct separate comparative censuses of these habitat types because of the extensive ecotones occurring between them. However, care was taken to cover each of the types in such a manner that the amount of time spent in each was approximately proportional to the relative expanse of each within the total area.

There are admittedly many variables which enter into work of this type. While attempts were made to reduce many of them, there still remain a few which were impossible to avoid by any amount of attention. The variation in vocal activity between various species would be a good example of this. Usually, however, natural compensating factors were present which would tend to neutralize the effects of such variation on the results of the census. Because of these variable factors, the resulting data on relative abundance should not be con-

sidered as absolute, but only as indicative of the general prevalence of the species and the larger taxonomic groups. At the very least, the results of using this method are certainly more accurate than relative abundance determinations based on general observations alone.

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A STUDY OF THE VIOLET-GREEN SWALLOW

BY J. M. EDSON

FOR many years I have been observing the habits of the Violet-green Swallow, *Tachycineta thalassina lepida*, in the vicinity of Bellingham Bay, western Washington. During that time a considerable volume of notes has been accumulated, from which I have endeavored to epitomize the significant facts.

Of the five species of swallows common to this region, the Violet-green is first to arrive in spring, although the Tree Swallow, *Iridoprocne bicolor*, is scarcely later. The earliest appearance is ordinarily in the latter part of March. The three other species arrive considerably later. The Violet-green likewise is first to leave when nesting is over, taking its departure in late July or early August. My records of first arrivals during 35 years range in date from February 25 to April 7; March 21 is about the average. February 25, 1906, the earliest spring date, was quite exceptional; the next earliest was March 12. The latest arrival date recorded was April 7, 1917. Of course it is quite possible that previous arrivals escaped observation. That no doubt did happen in numerous instances. The first appearance in March seems often to be followed by an interval before others of the species are seen. Following the second wave they become common. The earlier birds sometimes appear in considerable flocks, quickly passing on, likely destined for some habitat farther north.

Upon arrival, the local birds promptly visit their last year's nesting quarters and perch on wires at accustomed places. By the middle of April, on the average, the birds commence to evince an interest in nesting. However, activities are not usually started in earnest till about the second week in May. The eggs are laid usually late in May or early in June. In ten nestings the earliest hatching date was June 6, the latest July 11 (a second effort). The average date is June 20. The average date of leaving the nest is July 13. The incubating period is approximately fifteen days, and the brooding period twenty-

three or twenty-four days, sometimes even longer. These periods seem to be somewhat variable, the process being sometimes retarded slightly.

For nesting quarters they readily accept a bird house or a box attached to a building. An aperture in a cornice or a wall is satisfactory, or even a hole in a tree. A crevice in a stone wall or rocky cliff is sometimes used. An apparently open nest on a ledge beneath a cornice was once observed. In building the nest, small twigs and grass stems or rootlets are used and the cavity chosen is well filled. It is finished with a copious dressing of hen's feathers. Sometimes it is a sort of double nest, with a second compartment in another corner. This is sometimes occupied by the parent when nights are warm. The time taken for nest construction is variable, being sometimes a few days and again many. Occasionally eggs are laid before the nest is completed, and the feathers are added while laying is in progress. An egg a day is laid in most cases till the clutch of five is complete. In one instance there were six eggs; in another, four. One nest contained but two, and at another time there were only three. In these latter instances broken shells were found below the nests as evidence that they had been pillaged by some marauder, likely a wren. It is not unusual for incubation to be commenced before the clutch is complete. Seldom are all the young hatched on the same day. In one case hatching required five days.

The only enemies that have interfered with the nesting are the English Sparrow, *Passer domesticus*, and the Western House Wren, *Troglodytes aëdon parkmani*. Cats have sometimes watched the birds and made futile attempts to reach the nests. The sparrows, while often very annoying, have not done material harm when the entrance to the nest has been properly proportioned. The wrens are more difficult to circumvent. Jealousy is their outstanding characteristic, and they are likely to destroy eggs in any nest in proximity to their own, not excepting those of their own species. In latter years I have kept nesting boxes duly separated, and the swallow nestings have been successful. Once a wren's egg, ironically, was added to the swallow's clutch.

The particular nesting box which has been a source of information of recent years is suspended with a northwest exposure from a peg beneath the eaves of a sleeping porch. The lid is removable. In size it is $4\frac{1}{4}$ by $4\frac{1}{2}$ by 6 inches. The somewhat elliptical entrance is $1\frac{1}{4}$ inches in width by $1\frac{1}{8}$ high, and is located near the top of the front side. Often the birds hole up in the box for the night before eggs are laid. Occasionally one bird spends the night on top of the

box while the other is inside. Following completion of the nest, commonly little is seen of the birds during the laying and incubating periods unless there happen to be meddlesome sparrows or wrens about. However, as soon as the eggs are hatched the birds begin their activities, and there is much going and coming. During the daytime the birds are off the nest much of the time in the incubating period. With a maximum temperature of 72° F. they remain off nearly all day. When a morning temperature was 58° F. a bird was found in the box but off the eggs. The case often was the same at 10 P. M. In one instance no swallow came to the nest in all the afternoon till 8:33 P. M. The infant birds sometimes broke from their shells in the absence of the parent, although usually the parent was present at such times. On cloudy and cool days the birds were more likely to be at home. When hatched, the young require very little brooding, and none at all after the feather growth is well started. Once about mid-day, when sparrows were haunting the neighborhood, a swallow sat tight on the nest and refused to budge even when I tried to remove it, taking no chances on sparrow behavior. Ordinarily, I could take a swallow off the nest with scarcely any resistance.

One day in 1929 there was strife for choice of nesting boxes among sparrows, wrens and swallows. The eggs of the swallows had been destroyed. Thereupon the sparrows were condemned and duly executed—possibly a perversion of justice. Then the swallows transferred their endeavors to the box in which the sparrows had left a nearly completed nest of coarse construction. They merely added a lining of feathers, and then three eggs were promptly laid. A brood of three was successfully reared. In 1934 a clutch of four eggs was destroyed (likely by wrens), yet the swallows maintained possession of the nest and four days later a second clutch was commenced with ultimately five eggs, followed by successful incubation. Once while the swallows were building and a week before the first egg was laid the sparrows attempted a conquest. A swallow defender would maintain possession by sitting patiently on the empty nest for long periods. The swallows rarely showed pugnacity or any violent propensities, yet have been seen to pursue a bothersome sparrow hotly.

The swallows show little fear of me, perhaps regarding me as somewhat of a protector. On one occasion, following the desecration of one of their nests, I decided to take a hand in the battle against the attacking sparrows. The combatants were milling about the nest as I arrived with the .22-rifle. A swallow came and perched on a wire near me. Then a cock sparrow settled on the same wire scarcely more

than a foot from the swallow. As the weapon went into action the sparrow dropped to earth, quite dead. The swallow surprisingly did not dart away in fright but sat placidly surveying the fallen enemy.

At hatching, the delicate skin of the tiny swallows is of a pale pinkish color. There are slight wisps of creamy down on the back, crown, and scapulars. The gape is margined with a whitish, lip-like roll, and the dark eyeballs are visible through the skin. In the succeeding days the skin color soon deepens and the down becomes darker and more prominent. By the fifth day the developing feather follicles of ashy color show plainly through the skin of the upper parts, giving them a much darker appearance, while the down is diminishing. At seven days old the upper parts appear uniformly ashy gray. At eight or nine, a small horizontal slit at the center of the eyeball precedes opening of the eyes, which are completely open about two days later. The remiges are now about to break through their epidermal sheaths. At ten days they project an eighth of an inch and white feathers along the side of the body appear. Blackish speckling shows amongst the expanding gray feathers of the back. At thirteen days old the nestlings have primaries an inch long and half out of the sheath, with rectrices half as long. The sides are well covered with silky white feathers. By the thirteenth day the plumage is taking on a mature appearance, black replacing the ashy gray. The primaries lap half down the tail. By the eighteenth day the young have almost the appearance of adults, except for prominence of the abdomen, which has heretofore been very conspicuous but now is declining. With the twenty-second day the abdomen is well reduced and some signs of violet and green coloring appear above, while down has become very scanty. The wings and tail have about reached their full development. Henceforth, a careful look is needed to distinguish the young from the old birds.

Soon after the young have broken from their shells their little wide-open mouths are upstretched, and the parents are promptly responsive to the appeal. For two weeks they keep up diligent pursuit of gnats and flies from sunrise to sunset. The morning awakening comes at 4 A. M. or a bit earlier. Often there is an audible stir in the nest box some minutes before the birds emerge. When timed in the feeding period it was found that the parents arrive at the nest every two minutes or oftener during the morning hours. There is a slackening of activity at times, particularly in the afternoon. Frequently a little troupe of visiting swallows from nearby localities circles about to inspect the situation. Their interest always seems

friendly and with the acquiescence of the home birds. After the lapse of about sixteen days the nestlings, well clothed and with bulging bellies, commence a reducing process. The original ravenous appetites have been appeased and food supplies much reduced. When the box is opened there appears a galaxy of suspicious little eyes intently fixed upon the intruder where before were the gaping mouths. They resent attempts to handle them, and shortly will be alert to escape from the box when disturbed. For hours at a time the old birds remain absent, while the young like to sit before the opening and gaze out upon the world they are soon to explore. The nest is kept wholly clean while the nestlings are small, but after their eyes are open the surroundings become progressively foul. Sometimes a remote corner of the box is used as a latrine.

A few times in different years, botflies have victimized the nestlings and they were relieved of a number of large maggots. No fatalities resulted but it was detrimental to health and growth. Sometimes the old birds, or perhaps the young ones, will occupy the second nest compartment heretofore mentioned, especially if the first has become markedly unclean. At the age of ten days the youngsters are too lively to be weighed without being enclosed in a paper sack. At twenty-one days they are alert to fly if allowed an opportunity, and they are capable of very good performance. When ten days old the little ones are able to give voice to a faint, wheezy peeping; the notes perhaps may be represented approximately by the syllables, *chip-py*. The voices of the adults are heard but little, for they are a very quiet species.

When the young are fully matured the coming-out event is an important occasion, and takes place when the young are twenty-three or twenty-four days old or rarely even a day or two later. Often visiting swallows are in attendance. It may happen at any hour of the day except a late one. The youngsters make their take-off one at a time, at irregular intervals. Sometimes not all of them venture out the first day, some waiting till the next. Commonly there is no returning to the nest once it is vacated, but again some have returned for a night or two. When all are finally out they depart at once for new fields, perhaps for a time to patrol some nearby valley or lake. By the end of July they have practically disappeared from this vicinity. I have a few August records but none later than the 12th. In the latter half of July they may be seen flocking with Barn Swallows and others on wires and roofs. However, the Barn Swallows remain with us much later.

With a view to ascertaining the daily growth of the young swallows, a series of measurements of their length was attempted in 1932, but after the thirteenth day the effort was abandoned on account of growing resistance on the part of the subjects. The first day's measurements of the four in millimeters were 40, 41, 42, 45. The thirteenth day gave 93, 93, 95, 98. The tenth day showed an excessive growth for all, it being 9, 9, 10, 11 millimeters for the one day. The average during the period was 4 millimeters per day, although it was unequally distributed as between individuals. Adults average about 127 millimeters in length.

A better and more illuminating method of ascertaining the daily development was by recording the weights of the nestlings each day as nearly as practicable at a definite hour. This plan brings out some interesting facts concerning the recession in weight which these swallows undergo when their development is about two-thirds advanced (see Edson, Condor, 32: 137-141, 1930).

AVERAGE DAILY WEIGHT IN GRAMS OF NESTLINGS

| <i>Days Old</i> | <i>1929</i> | <i>1930</i> | <i>1932</i> | <i>1937</i> |
|---------------------|------------------|------------------|------------------|------------------|
| 1 | | 1 $\frac{3}{8}$ | | |
| 2 | 2 $\frac{3}{4}$ | 2 $\frac{3}{8}$ | 2 | 2 $\frac{1}{8}$ |
| 3 | 4 | 4 $\frac{1}{8}$ | 3 $\frac{3}{8}$ | 4 $\frac{3}{8}$ |
| 4 | | 6 $\frac{3}{8}$ | 5 $\frac{3}{8}$ | 5 $\frac{3}{8}$ |
| 5 | 7 | 8 | 7 | 8 |
| 6 | | 10 $\frac{3}{8}$ | 9 | 8 $\frac{1}{8}$ |
| 7 | 10 $\frac{3}{8}$ | 12 $\frac{1}{8}$ | 11 $\frac{1}{8}$ | 11 |
| 8 | 13 $\frac{1}{8}$ | 13 | 14 $\frac{3}{8}$ | |
| 9 | | 15 $\frac{1}{8}$ | 14 $\frac{3}{8}$ | 12 $\frac{1}{8}$ |
| 10 | 16 $\frac{1}{8}$ | 16 $\frac{3}{8}$ | 14 $\frac{1}{2}$ | 14 |
| 11 | 16 $\frac{1}{8}$ | 19 $\frac{1}{8}$ | 16 $\frac{1}{2}$ | 14 $\frac{1}{8}$ |
| 12 | 18 $\frac{1}{8}$ | 20 | 17 $\frac{1}{4}$ | 14 $\frac{3}{8}$ |
| 13 | 19 $\frac{3}{8}$ | 20 | 18 $\frac{3}{4}$ | 13 $\frac{1}{8}$ |
| 14 | 19 $\frac{3}{8}$ | 21 | 20 | 15 $\frac{1}{8}$ |
| 15 | | 21 | 20 | 17 $\frac{1}{8}$ |
| 16 | | 21 $\frac{1}{8}$ | 17 $\frac{3}{4}$ | 18 |
| 17 | 20 $\frac{3}{8}$ | 20 $\frac{3}{8}$ | 17 | 18 $\frac{3}{8}$ |
| 18 | 20 $\frac{1}{8}$ | 20 $\frac{1}{8}$ | 17 | 18 $\frac{1}{8}$ |
| 19 | 20 | 19 $\frac{1}{8}$ | 18 $\frac{1}{2}$ | 19 |
| 20 | 19 $\frac{3}{8}$ | 18 $\frac{1}{8}$ | 18 | 18 $\frac{3}{8}$ |
| 21 | 19 $\frac{1}{8}$ | 18 $\frac{1}{2}$ | 17 $\frac{3}{4}$ | 17 $\frac{3}{8}$ |
| 22 | | 17 $\frac{3}{8}$ | 16 $\frac{3}{4}$ | 17 $\frac{1}{8}$ |
| 23 | 17 | 17 | 16 $\frac{1}{4}$ | 17 |
| 24 | 17 $\frac{1}{8}$ | 17 $\frac{3}{8}$ | | 16 $\frac{1}{8}$ |
| 25 | 16 $\frac{3}{8}$ | | | |
| 26 | 15 $\frac{3}{4}$ | | | |

It will be observed that in different years weights at a particular age corresponded only approximately. In fact, there is a noticeable variation in the progress of development in different years. In 1930, with a brood of three, the maximum weight was reached on the sixteenth day, and was $21 \frac{3}{5}$ grams. In 1932, with five young birds, the maximum came on the fifteenth day, with 20 grams. With five young in 1937, the high point was not reached till the nineteenth day, and was only 19 grams. The average weight of adult swallows I have found to be not quite 16 grams, which also is close to the maximum. Hence, in those cases where the young have left the nest at a weight greater than 16 grams it is logical to conclude that the reducing process was incomplete at that time. There is also much variation in the development of individuals of the same brood. This in part is accounted for by irregularity of hatching, though not wholly. In one case the last bird hatched was four days younger than the oldest, and too far behind to keep up with its mates—it lived only five days, an instance of submergence of the weakest. Again, with only one day's difference in age a nestling exhibited unusual precocity. Its wings and tail were much the longest of the brood, with generally more advanced development and diminished weight. In the evening of the twentieth day, on being disturbed, it suddenly flew from the nest, and its flight was about as steady and efficient as that of an adult. It continued in the air till lost to sight. The evening of the twenty-second day this bird was found again in the nest with the others after an interval of 48 hours. On the twenty-third evening it took off for another absence, and the following evening it was back once more. Early on the twenty-fifth morning the entire brood departed.

There are a number of factors that seem likely to have contributed to the disparity of the recorded weights: varying abundance of food in successive years, the number of nestlings to be fed, stormy weather preventing the flying of insects, persistent annoyance at times by English Sparrows, difficulty of exactly checking the time of hatching of each bird and maintaining identification, and occasional irregularities of intervals between weighings.

Weights usually were taken near the close of day. One on the eleventh day at 4:10 A. M., to test the nightly loss of weight, showed a reduction of 0.9 gram, which, however, was more than recovered before nightfall. Everything considered, there is nothing to obscure the interesting facts that these young swallows, when nest life is about two-thirds complete, attain a weight far above that of adults of their species, and that this is followed by a period of progressive reduction.

The year 1936 brought a story of unprecedented disaster to the early flight of Violet-green Swallows. March 22 was a sunny spring day and numbers of these swallows were to be seen skimming over the lowlands. But a northeast wind came that night, and morning found the air filled with snowflakes which soon whitened the ground. It grew still colder and on the 24th there were three inches of snow. The freezing mountain breeze continued for several days, and by the 29th the mercury had reached 23 degrees above zero. On the 30th, as the weather moderated, reports were received of the finding of dead swallows at various points. A friend brought me the bodies of five that he had found in one locality. The birds had sought shelter under the eaves of a building near the foot of Lake Whatcom. There they had remained till starvation impelled them to feeble attempts at flying, which were of brief duration, ending with a fall to the snowy shroud that awaited them. The normal weight of sixteen grams had dwindled to eleven as the end came. I heard reports of many others being found where they had perished at various concentration points. That storm extended throughout a long stretch of the Pacific Coast region and the destruction of these swallows must have had proportions of a major disaster. When another week had passed, our local Violet-greens arrived for the summer, apparently scarcely reduced in numbers.

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THE 1940 NESTING POPULATION AT PLEASANT VALLEY SANCTUARY, LENOX, MASSACHUSETTS

BY GEORGE J. WALLACE

So many comments, both verbal and in print, have been made regarding the shortage of birds following the almost unprecedentedly severe winter of 1939-40, that 1940 nesting records in comparison with those of previous years should lend needed statistical support to more casual observations. Birds of passage are difficult to estimate accurately, especially when migratory flights are coincident, as they were in the spring of 1940, with extremely unfavorable conditions for observations in the field; but records of summer residents kept at one station over a period of years should be a more dependable measure of the changed or changing status of certain forms. Figures for the 1940 nesting season at Pleasant Valley Bird and Wild Flower Sanctuary in Lenox, Massachusetts, compared to those of 1938 and 1939, rather vividly disclose the reduced status of many species—changes

that for the most part, though not without exception, seem logically traceable to the hard winter in the southern states.

Some eight or ten species that nested more or less regularly at the Sanctuary in earlier years were absent in the 1940 breeding season, and at least eleven others showed a marked decline in numbers. There were a few gains, notably among certain warblers, Scarlet Tanagers, and Indigo Buntings, but they hardly began to compensate for the losses that occurred.

For the most part it is evident that species wintering in the southern states were the hardest hit and that those wintering farther south in Central or South America returned to their summer haunts in the usual, or even increased, numbers. Coincident with the shortage assumed to be due to the severe winter in the United States, was an accompanying scarcity among northern insectivorous species whose decline was under way long before the onset of the winter in question. Chickadees, White-breasted Nuthatches, and Downy and Hairy Woodpeckers returned to the Sanctuary feeding stations in the fall of 1939 in greatly reduced numbers, before the climatic ills of the winter had had a chance to operate. Three apparently independent features, then, combined to produce the notably poor bird season in the spring and early summer of 1940: (1) unfavorable conditions for observations in the spring; (2) a decline, presumably cyclic and not related to the winter in question, among northern insectivorous species; and (3) severe winter-killing of birds in the southern states.

Following is an account, systematically arranged, of the breeding birds at the Sanctuary that showed the most significant changes in numbers, for good or bad. Estimates given for the number of breeding pairs are based chiefly on the time-honored but not altogether accurate method of counting singing, territory-holding males, a method here somewhat strengthened by repeated observations throughout the season. In a few cases (Belted Kingfishers, Phoebe, Bluebirds, etc.) the actual nesting sites were known; in the many species represented by a few to a dozen or so pairs, the estimates are probably not far out of the way; but in species represented by 25 or more pairs (Song Sparrow, Catbird, Veery, Ovenbird, etc.) considerable guesswork was involved. The general trends here indicated, however, are believed to be portrayed with reasonable accuracy.

GREEN HERON (*Butorides v. virescens*). With the establishment of a beaver colony at the Sanctuary in 1932 and 1933 the Green Heron became a fairly regular summer visitor, and finally, in 1938, a summer resident. In 1939, young were reared in the vicinity of the beaver swamp, but in 1940 the species was reduced to the status of an occasional visitor.

SHARP-SHINNED HAWK (*Accipter v. velox*). The return of this species to a nesting site on the far ridge in the Sanctuary, after an absence of eight years, was probably a more or less accidental acquisition, not necessarily correlated with Sharp-shin population changes as a whole.

BROAD-WINGED HAWK (*Buteo p. platypterus*). The one or two pairs of Broad-wings usually resident in summer either failed to return or moved to a distant nesting site, demoting them to the occasional-visitor class in 1940.

WOODCOCK (*Philohela minor*). Many comments have been made relating to the effects of the hard winter on this species, but this was hardly measurable at the Sanctuary which seldom harbors more than one pair in summer. Either the species arrived nearly a month behind schedule or else postponed its vespertine nuptial ceremonies till an unusually late date (April 28 in comparison to March 31 in 1938), but apparently a pair remained in a nearby alder swamp for the summer.

BLACK-BILLED CUCKOO (*Coccyzus erythrophthalmus*). The apparent increase of this species by several pairs may be, at least in part, attributable to underestimation in previous years.

BELTED KINGFISHER (*Megaceryle a. alcyon*). The kingfishers that reared young in a gravel bank at the Beaver Pond in 1938 and 1939 failed to return in 1940.

WOODPECKERS (*Dryobates* sp.). The woodpeckers of this genus illustrate a decline among northern insectivorous species that can in no way be correlated with the hard winter in question. Four Hairy Woodpeckers and six Downy Woodpeckers patronized the cottage feeding stands throughout the winter of 1937-38 and the Downies were further augmented in the spring by the arrival of five or more individuals, but by the fall of 1939 the Hairies had diminished to a solitary male, not found mated in 1940, and the Downies were reduced to several individuals of questionable status.

PHOEBE (*Sayornis phoebe*). The five and four nesting sites located in 1938 and 1939, respectively, dwindled to three in 1940.

ALDER FLYCATCHER (*Empidonax t. traillii*). This species showed a decline from a probable five pairs in 1938 to three in 1939 to one in 1940. Since it winters in Central and South America, where companion species suffered no apparent winter destruction, this decrease must be attributable to other factors.

TREE SWALLOW (*Iridoprocne bicolor*). An almost calamitous reduction took place in the Tree Swallow population, which had increased from a single pair in 1933 to eight or ten nesting pairs in 1938 and 1939. Apparently none of them returned in 1940, for the three pairs that finally appropriated boxes did so in late May and June long after the former years' residents should have returned to lay claim to their previous nesting sites.

BLACK-CAPPED CHICKADEE (*Penthestes a. atricapillus*). Detailed studies of wintering chickadees over a three-year period disclosed a decline from about 60 winter residents in 1937-38 to approximately half that number in the winter of 1939-40. Here, as in the case of wintering woodpeckers, the decline was under way long before the onset of the severe 1940 season, though it appears that the rate of reduction was accelerated during the winter, possibly at a time when the cycle should have been recovering from its downward swing.

WHITE-BREASTED NUTHATCH (*Sitta carolinensis*). This species, which has been an unfailing winter (if not permanent) resident since 1935, shared the decline of other insectivorous winter birds, decreasing from five individuals in the winter of

1937-38 (their peak period) to a lone male in 1939-40. To date (February, 1941) none have appeared this winter. Mrs. Daniel Robert in New Lebanon Center, nearby, writes that the nuthatches that came to her feeding stands in 1939-40 sickened and died during the winter.

HOUSE WREN (*Troglodytes a. aëdon*). The decline in House Wrens took place in 1939 from about 15 pairs to about 8, with no perceptible change in 1940.

WINTER WREN (*Nannus hiemalis*). Included as a summer resident in 1938 on the basis of a singing bird on Lenox Mountain in June, in 1939 the bird was noted in summer only in a distant ravine just beyond the Sanctuary limits (nest with full grown young on August 31, a singularly late date). In 1940 the wrens were not found at either place.

CATBIRD (*Dumetella carolinensis*). The number of nesting Catbirds was arbitrarily set at about 25 pairs in 1938 and 1939, but though seemingly abundant in 1940, hardly half that number of nesting pairs could be accounted for.

HERMIT THRUSH (*Hylocichla guttata faxoni*). Though said to have suffered a marked reduction elsewhere and obviously scarce in migration, the nesting population at the Sanctuary at least held its ground if not gaining a pair or two. No difference was noted in the abundant Veeries (about 30 pairs) but the Wood Thrush dropped off slightly in both 1939 and 1940.

BLUEBIRD (*Sialia s. sialis*). For the first time since the founding of the Sanctuary in 1929, there were no nesting Bluebirds in the many boxes available. Though, for reasons not yet clear, Bluebirds have never increased to the extent that the available nesting sites would seem to warrant, a few pairs (usually two) have been unfailing until the blank summer of 1940.

BLUE-HEADED VIREO (*Vireo s. solitarius*). Summer records for this usually more northern species have been frequent but irregular in the past twelve summers. None remained in 1940 after the comparatively poor and considerably retarded spring migration.

GOLDEN-WINGED WARBLER (*Vermivora chrysoptera*). This warbler has shown a noticeable northward trend and an encouraging increase in recent years. Originally rare in Berkshire County, with no known nesting records, a pair came to the Sanctuary in 1938 and lingered into early June but were not found breeding. In 1939 a pair returned to the same location and in July were found feeding just-fledged young, a discovery made by Donald and Ian Bradburn, Berkshire summer residents from New Orleans. That spring, Golden-wings had been repeatedly observed in five different places on the Sanctuary grounds. In 1940, May migrants were back in full numbers, and one or two, possibly three, pairs remained into the breeding season; but strangely enough a Brewster's Warbler, the first in Berkshire annals, replaced the male Golden-wing on the 1939 nesting site, remaining in full song till mid-June when a male Golden-wing apparently took his place. No Blue-winged Warblers were found to explain the Brewster hybrid.

WARBLERS (*Dendroica* sp.). Except for the Myrtle Warbler which, for the second time in twelve years, was entirely missed in the spring migration, there was no appreciable diminution in Dendroican warblers, and the breeding Blackburnians and Black-throated Blues showed significant numerical gains.

NORTHERN WATER-THRUSH (*Seiurus n. noveboracensis*). This species completely deserted breeding haunts in the beaver swamp which it had occupied for six successive summers, and the Louisiana form (*S. motacilla*), resident along the woodland streams, decreased from two or three pairs to one.

SCARLET TANAGER (*Piranga erythromelas*). The popular impression of a 1940 increase in this species is supported by observations at the Sanctuary. At least seven singing males were summer residents in 1940, an increase of two over the highest previous year.

INDIGO BUNTING (*Passerina cyanea*). The increase noted in 1939 continued its upward swing in 1940, with three singing males (one a second-year bird in partial breeding plumage) in the immediate vicinity of the Sanctuary buildings and one to three others in remoter corners. In both 1939 and 1940 they remained in considerable numbers into early October, whereas there were no fall records during the ten preceding years. A sizable feed patch of mixed grains appeared to influence their later sojourn in 1939 and 1940.

SLATE-COLORED JUNCO (*Junco hyemalis*). The little colony of juncos, resident for several summers on Farviews (the 1800-foot ridge forming the northwest boundary of the Sanctuary), was believed to have disappeared in 1940 because several trips to the summit in May and June failed to disclose them; but on July 21 and again in August the Bradburn boys found one or more there.

WHITE-THROATED SPARROW (*Zonotrichia albicollis*). For eleven successive years (1929-39) the hordes of White-throats that pass through in spring never failed to leave behind from one to three pairs of summer residents, but in 1940 none was found in the nesting season.

SONG SPARROW (*Melospiza m. melodia*). Though the abundance of this species has prevented getting accurate census figures of breeding birds, it seems to have suffered a decline not entirely attributable to losses in the winter of 1940. The number of pairs, set with considerable uncertainty at 40 in 1938, was lowered to 30 in 1939 and to about 20 in 1940. Swamp Sparrows (*M. georgiana*) have shown a similar downward cycle on a much smaller scale.

Obviously not all of these data are indicative of widespread population changes, some being merely local and more or less accidental; but several general trends are disclosed. The most noticeable are the severe reduction among species wintering in the southern states and the earlier decline among northern insectivorous species. Less noticeable, and possibly of no significance, are accompanying losses among swamp-loving birds—Alder Flycatchers, Northern Water-Thrushes, Swamp and Song Sparrows—only part of which (if any) is attributable to the winter of 1940, since the decline was under way a year earlier and since all of the species in question do not winter in the critical areas. Possibly the drought of 1939 had a deleterious drying effect on swamp habitats, causing the would-be 1939 summer population to seek more favorable regions, but this conjecture as yet has no observational backing. Thus several apparently independent downward trends combined to produce the lowest summer resident population during the last three years (1938-40), if indeed not the lowest in the twelve-year period of the Sanctuary's history.

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GEOGRAPHIC VARIATION OF THE PIGEONS OF THE
GENUS *COLUMBA*¹

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DURING the past hundred years, numerous studies have been made of the relationship of body dimensions to the geographic distribution of animal species. From these investigations, two important generalizations have been derived. The first, known as Bergmann's Rule, states that warm-blooded individuals or races which inhabit cooler regions have larger general body dimensions than do those forms of the same species that live in the warmer climates (Bergmann, 1847). The other, known as Allen's Rule, is less generally applicable but states that, in the hotter regions, animals exhibit a *relative* increase in certain peripheral parts, such as the length of the tail and bill in birds, and the ears, tail, or feet in mammals (Allen, 1876, 1883, 1905). It has long been known that the cold-blooded animals tend to be larger in the warmer regions—their optimum habitat. Much evidence for the existence and operation of these rules has been submitted by Rensch (1929, 1933, 1936), whose work has been briefly summarized by Dobzhansky (1937), Robson and Richards (1936) and Huxley (1939).

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MATERIALS AND METHODS

In most older studies, a single species was examined—that is, the individuals, races, or subspecies within a species were compared. The present study extends beyond this category and considers the dimensions within a genus. The genus *Columba* was chosen because it has a nearly world-wide distribution. The measurements used in this work were taken from specimens in the collections of Field Museum of Natural History and from the literature, most of which was examined in the Ayer Library of the Field Museum of Natural History. Naturally, data so derived are subject to errors of many different sorts.

¹ Paper No. 274 from the Department of Genetics, University of Wisconsin.

The measurements of the birds are assumed to be representative of the species, but these measurements could never be considered accurate unless they were taken from a large sample of the population; as a matter of fact, a relatively small sample is usually used in determining the measurement of a given species. There is, further, some size variation among the races or subspecies of a species. For example, Griscom (1935) studying the races of *Columba fasciata*, found that there was a definite size gradient operating in terms of geographic distribution. Thus, the individuals or races in the United States were larger than those in Mexico which, in turn, were larger than those in Nicaragua. Size steadily decreased southward. In the present paper, it has often been impossible to obtain measurements of the representatives of a given species that inhabit a particular area. Frequently, for example, the measurement of a South American bird was plotted as representative of the dimension of the Central American form. Obviously, such a procedure is fraught with error, particularly in the light of Griscom's experience and that of others. But since measurements of the Central American forms, in this case, were not available, it became necessary to use the other value. Migration of species introduces error. Some species migrate little, if any, while others migrate thousands of miles every year. Furthermore, some individuals of a species migrate great distances, while other individuals of the same species do not. For this reason the measurements of a given bird, supposedly inhabiting a particular area, are not necessarily measurements that should be taken as representative of the species of that region. Naturally, this is a source of error difficult or impossible to eliminate.

The geographic distributions of the various species and subspecies of *Columba* were plotted on outline maps of the world. These distributions, as well as the taxonomic determinations of genus, species, and subspecies, were taken largely from Peters (1937). Supplementary data as to distribution were derived from various sources when necessity required. One should recognize that distributions, as reported in the literature, seldom reveal the exact range of a species. At best, they tell us where the bird has been found. Hence, in formulating physiological principles on the basis of such data, one must always bear in mind that there probably are errors inherent in the method, which may have considerable influence on the nature of the conclusions.

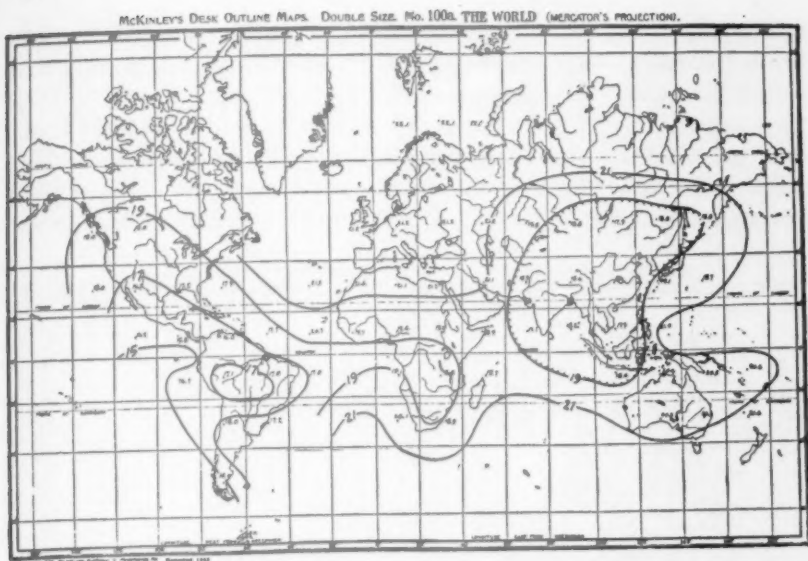
The outline maps of the world on which the distributions were plotted are based on Mercator's projection. In a Mercator projection,

the lines of latitude are parallel as likewise are the lines of longitude, and these together thereby describe a rectangle or quadrangle. Twenty degrees of latitude and twenty degrees of longitude, near the Equator, approximate a square. Toward the poles the same dimensions appear as an elongate rectangle with its greatest length north and south. The length exceeds the breadth by two or three times. These features may be observed in the several maps presented below.

Many of the species of *Columba* overlap in their ranges and inhabit the same regions. Therefore, in plotting the geographic distribution of the species, it was found that from one to a dozen species may live within any single quadrangle defining 20° of longitude and latitude. If there is a correlation between size of the organism and its geographic distribution, such as is implied in Allen's or Bergmann's rules, then the species of *Columba* which inhabit a quadrangle defining 20° of longitude and latitude near the Equator should be appreciably different from those species which live within a similar rectangle nearer to one of the poles. But, as a matter of fact, any given quadrangle is usually inhabited by large, medium-sized, and small species. Hence, obvious exceptions to any application of Bergmann's or Allen's rules become apparent or even striking.

Averages were taken of the measurements of each of several different body parts of species inhabiting the same 20° quadrangle. This was repeated for all the 20° quadrangles through which the *Columba* species ranged. Some of the quadrangles were represented by only one species, others by as many as a dozen. It was reasoned that if there was a correlation between environment and differences in total length, let us say, of the species of *Columba*, then such a correlation should become apparent by the method herein employed.

The body parts considered were: (1) total length of the bird; (2) wing length; (3) tail length; (4) length of culmen; and (5) tarsal length. The average measurement of all the species in a given quadrangle was placed beside a point in the center of that quadrangle. For example, the following species of *Columba* with their respective culmen lengths, were found to occur in latitude 0°–20° N., longitude 40°–60° E.:—*albitorques*, 20 mm.; *oliviae*, 22 mm.; *arquatrix*, 19 mm.; *delegorguei*, 17.3 mm.; *guinea*, 22.3 mm.; and *livia*, 19 mm. The average of all these measurements is 19.9 mm., which is the datum which may be observed in the center of the rectangle 0°–20° N., 40°–60° E. In this manner, the various points and values shown in Text-figure 1 were produced. Since these points were placed in the centers of the rectangles of longitude and latitude, many points will

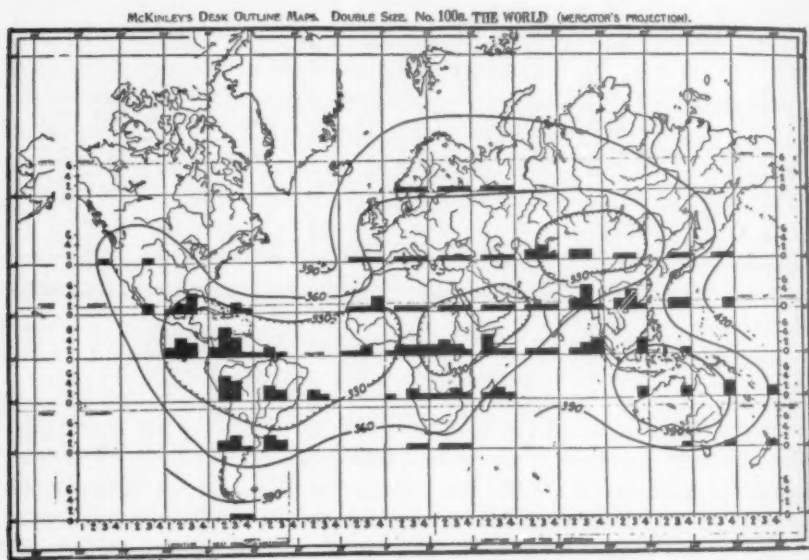
TEXT-FIGURE 1.—CULMEN LENGTH OF *Columba* SPECIES.

Contour Interval: 2 mm. of culmen length.

be observed to occur in the oceans, adjacent to continents or islands. This practice is not without undesirable features, but it was followed mainly because of the resulting regularity and ease of delineation. The points could be placed on the mainland, where the birds actually occur, rather than in the oceans, which would present a more accurate picture, but this would introduce technical difficulties not easily overcome. For example, where would the point be placed in latitude 0° – 20° S., longitude 40° – 60° E.? In this rectangle four species occur. One of them, *C. pollenii*, is found in the Comoro Islands, while the other species, *arquatrix*, *delegorguei*, and *guinea*, are found on the nearby African mainland. Obviously, if the point were placed on the mainland, the curve would be unreasonably distorted,—even as would be the case if the point were on the islands. Similarly, the geographic center of the land surface that exists in any given rectangle of latitude and longitude would have to be computed in order to determine logically just where the point should be placed. For these reasons, it was thought desirable to put the points in the center of each rectangle, irrespective of where they actually fell with reference to land surface.

When all the values were plotted for average culmen length, isometric lines were drawn, connecting points of equal value. Thus,

in Text-figure 1, the 17 mm. isometric line crosses southern California between values 16.7 and 18.0, crosses Texas between 16.7 and 17.2, and enters South America between values 16.0 and 17.7. The other isometric lines were drawn in a similar manner. Values greater than the isometric value remain on the same side of the line in all cases, and lesser values remain on the other side. For example, between the 15 mm. and 17 mm. isometric lines there are no values greater



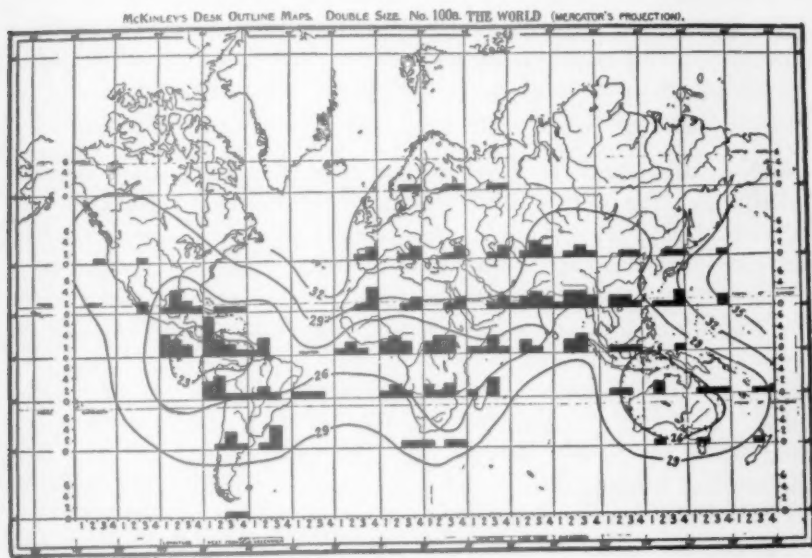
TEXT-FIGURE 2.—TOTAL LENGTH OF *Columba* SPECIES.

Block Graphs.—The ordinates in each quadrangle represent the number of species; the abscissas, the measurements, as follows: 1st Quartile: 275 mm. or less, total length; 2nd Quartile: 276–325 mm.; 3rd Quartile: 326–375 mm.; 4th Quartile: 376 mm. or over. Contour Interval: 30 mm. of total length.

than 17 nor less than 15. Therefore, the direction and disposition of an isometric line are reasonably controlled; and, given the same values, any two investigators would be compelled to map a region in much the same way. The contours of Text-figures 1–3, inclusive, were made in this way.

The averages shown in Text-figure 1, for culmen length, are not to be taken too literally. Similar figures have been omitted from Text-figures 2 and 3, so as not to convey an erroneous impression. They were included in Text-figure 1 merely to demonstrate how the isometric lines on all the maps were determined. These average

values, as was pointed out earlier, are crude values and were not weighted in terms of variability or frequency of the species inhabiting a given quadrangle. For example, *livia* and *delegorguei* both inhabit the quadrangle 0° – 20° N., 40° – 60° E. However, let us assume that *livia* is represented in this quadrangle by 100 individuals, while *delegorguei* is represented by only ten individuals. It is unsound to give these two species the same weight in computing the average. In



TEXT-FIGURE 3.—TARSAL LENGTH OF *Columba* SPECIES.

Block Graphs.—The ordinates in each quadrangle represent the number of species; the abscissas, the measurements, as follows: 1st Quartile: 24.0 mm. or less, tarsus length; 2nd Quartile: 24.1–26.0 mm.; 3rd Quartile: 26.1–28.0 mm.; 4th Quartile: 28.1 or over. Contour Interval: 3 mm. of tarsus length.

the quadrangle 0° – 20° N., 60° – 80° W. there were fourteen species, of which the smallest had a total length of 258 mm. and the largest had a total length of 404 mm. This represents a wide range of values; similar variability was observed in many of the quadrangles. One wonders if the variability among the species within a given quadrangle would not be as great as, or greater than, the variability between quadrangles. No entirely adequate statistical method of determining the reliability of these averages could be found. Hence it was thought desirable to illustrate the range of variability of the species within a given quadrangle, along with the trend of the genus as a whole.

Variability of the species within each quadrangle was represented by the block graphs in Text-figures 2 and 3. In these graphs the abscissas, representing measurements of length, are subdivided into four quartiles; and the ordinates are subdivided in terms of the number of species. The value of each quartile is given with the legend to each of the figures. Thus, in Text-figure 2, quadrangle 0°–20° S., 60°–80° W. is inhabited by five species of average total length of 276–325 mm., and four species of 326–375 mm.

In Text-figures 2 and 3, therefore, one may observe the trends in the isometric lines and at the same time gain an understanding of the variability of the species, by observing the block graphs.

RESULTS

Before discussing the positive results of this work, the materials upon which the results must necessarily be founded should be considered. The validity of any conclusions presented herein is obviously dependent upon the quality of the original data. Above, I have pointed out errors inherent in this study. I wish to emphasize further the difficulties and incongruities with which one must cope in an investigation of this sort.

Let us analyze some of the data presented in the "Total length" map, Text-figure 2. For convenience, we shall consider the quadrangles 0°–20° S., 60°–80° W., and 20°–40° S., 60°–80° W. The species that inhabit these quadrangles, together with their respective total lengths, are as follows: Quadrangle 0°–20° S., 60°–80° W.: *albilinea*, 345 mm.; *picazuro*, 348 mm.; *oenops*, 343 mm.; *plumbea*, 313 mm.; *goodsoni*, 292 mm.; *maculosa*, 368 mm.; *subvinacea*, 295 mm.; *speciosa*, 315 mm.; *rufina*, 319 mm.; average of all species, 327 mm. Quadrangle 20°–40° S., 60°–80° W.: *albilinea*, 345 mm.; *picazuro*, 348 mm.; *araucana*, 409 mm.; *maculosa*, 355 mm.; *speciosa*, 315 mm.; *rufina*, 324 mm.; average of all species, 349 mm. The difference in the averages for the two quadrangles is 22 mm. and the standard deviation of the difference is 16.5.

One may readily observe that there is great variability among the species within a given quadrangle. Thus, in the quadrangle 0°–20° S., 60°–80° W., the smallest form is 292 mm. long, and the largest 368 mm., a difference of 76 mm. Similarly, there is a difference of 94 mm. between the smallest and largest species in the quadrangle farther south. Since this variability *within* a quadrangle is so great, it becomes evident that the variation *between* quadrangles is necessarily of doubtful validity. Furthermore, the averages presented are, in reality, more or less fictitious since an average, to be worth anything

at all, must imply somewhat of a regular dispersion of the population. In the present case, it is obvious that there is an irregular dispersion of values over a broad range. The standard deviation of the difference between the two averages further emphasizes that there is greater variation among the species within a quadrangle than between the species of the two adjacent quadrangles. The difference between the two averages is only 22 mm., while the standard deviation of this difference is 16.5; hence the difference is statistically insignificant. A similar analysis may be made of other quadrangles, with similar results. Thus we are prone to view the results presented herein more in terms of their "trends," rather than in terms of their statistical significance. For a set of figures may well reveal a trend without having statistical significance.

Let us now examine the data in another manner, considering the species that inhabit the quadrangles 0° – 20° S., 20° – 40° S., and 40° – 60° S., all longitude 60° – 80° W. The measurements of the *Columba* species found in the first two quadrangles have already been presented. In the quadrangle 40° – 60° S., 60° – 80° W., only two species have been found,—*araucana*, 409 mm., and *maculosa*, 355 mm. in total length. The average of these values is 382 mm. Now if we examine the data for all three quadrangles, we find that the smallest species, *goodsoni* (292 mm.) and *subvinacea* (295 mm.), occur near the Equator. Some of the larger species such as *maculosa* (368 mm.) and *picazuro* (348 mm.) also occur in this region. As we go farther south, away from the Equator, the smaller species drop out, leaving the larger. *Columba goodsoni*, *subvinacea*, *plumbea*, and *oenops* are found in latitudes 0° – 20° S., but not in latitudes 20° – 40° S. With the exception of *oenops*, all of these are smaller forms. An additional species, *araucana*, inhabits latitudes 20° – 40° S. but is not found in the more equatorial regions. Passing on farther south, other species drop out, and only *araucana* and *maculosa* live in latitudes 40° – 60° S. Both of these species are relatively large. Thus, the equatorial forms are usually numerous and of great variability, whereas nearer the poles the species are considerably fewer and are most often of large size. One might reasonably inquire whether, if there were as many species in Tierra del Fuego as at the Equator, there might not be just as diverse a group at the Cape as there is farther north. It is apparent that we have larger average sizes of birds at the Cape mainly because the smaller forms, which inhabit equatorial regions, do not extend their ranges into the colder countries. We have no way of knowing what their size would be if they did range southward to Cape Horn.

However, the studies of Rensch, Bergmann, and others have demonstrated that within many species there is a climatic gradient in which the larger subspecies occur in the colder regions, and vice versa. It should be remembered that Rensch and others have reported a high percentage of exceptions to Bergmann's Rule. Obviously, among subspecies and even higher categories, this rule is hardly empirical.

TOTAL LENGTH OF *Columba* SPECIES

Figure 2 demonstrates variations in total length of the *Columba* species. This map suggests that a larger proportion of the smaller forms are to be found in a belt which extends along the Equator in Central and South America, and in Central Africa; thence it deflects northeastward into Asia. In the region that embraces Mongolia, East Turkestan, northern Tibet, and northwestern China, there is a greater proportion of small forms. In the Americas, as we go farther and farther from the Equator, only large species are found. Thus, the equatorial forms occur within the 330 mm. isometric lines whereas the species more distant from the Equator extend even beyond the limits of the 360 mm. line. Similarly, there is a greater proportion of large African species distant from the Equator than in the equatorial districts. From northern Africa to the Scandinavian countries the change is more gradual, but nevertheless the Scandinavian forms include more large species than do the African. The Gobi Desert species are much smaller than the European in the same latitudes. To the east of Mongolia the species are larger, and attain their greatest lengths in the Bonin Islands, southeast of Japan. The Australian species, and those in the nearby islands to the north, likewise are of large size.

If one observes the block graphs that occur between the meridians 60° W. and 80° W. longitude, the size trend of the species is further illustrated. Thus, between 20° and 40° N. latitude the species all fall into the third and fourth quartiles. Between the Equator and 20° N., and the Equator and 20° S. latitudes most of the species fall in the second or first and second quartiles. Farther south, the bulk of the species that are represented occur again in the third and fourth quartiles. Similar analyses may be made of any group of block graphs, although, obviously, the results will not always be as striking as those mentioned here.

It is apparent, therefore, that length of the pigeon species is broadly related to their geographic distribution. Seemingly, the hotter the climate, the shorter the species. Table 1 presents data relating to this correlation. In this table the average lengths and their standard

TABLE 1

| Mean Annual Temperature | No. of Species | Total length (average) | Body length (computed average) | Wing length (average) | Tail length (average) | Tarsus length (average) | Culmen length (average) |
|-------------------------|----------------|------------------------|--------------------------------|-----------------------|-----------------------|-------------------------|-------------------------|
| 60°-70° F. | 22 | 376.0±8.8 | 232.4±5.6 | 222.4±3.7 | 138.2±3.4 | 29.1±0.60 | 19.3±.47 |
| 80° F. + | 33 | 338.3±8.1 | 211.1±5.9 | 202.0±4.8 | 127.6±3.1 | 25.6±0.76 | 17.9±.54 |
| Difference | | 37.7 | 21.3 | 20.4 | 10.6 | 3.5 | 1.4 |
| S.D. (difference) | | 11.96 | 8.78 | 6.06 | 4.58 | .96 | .72 |

deviations are recorded for all the species inhabiting regions of two different mean annual temperatures.

In order to arrive at these figures, the ranges of the various species were superimposed on a temperature map of the world. This map, taken from Davis (1902), featured isothermal lines of 10° intervals, showing the mean annual temperature of the globe in degrees Fahrenheit. On Davis's map, the 80° F. isothermal line roughly parallels the Equator and rarely extends as much as 20° of latitude north or south of it. Other isothermal lines more or less parallel the 80° isotherm, and thereby define broad temperature belts, extending east and west. The 50° F. isotherm passes along the U. S.-Canadian border, thence eastward to the south of England, the northern part of the Caspian Sea, and intercepts Japan at about the 40° parallel of latitude. It more or less follows the 40° parallel across the Pacific. In the Southern Hemisphere, the 50° F. isotherm crosses South America between 45° and 50° S. latitude, thence almost due eastward to the southern tip of New Zealand, thence east to South America.

The ranges of the various species, then, were superimposed on the temperature map. If a species ranged entirely within the 80° F. isotherm, it was tabulated accordingly. If it ranged between the 50° F. and the 80° F. isotherm, it was tabulated in the 50°-60°, the 60°-70°, and the 70°-80° F. categories. In order to construct Table 1, an average was taken of all the values for total length, let us say, that occurred in the 60°-70° F. category. Similar calculations were repeated for the 80° F. + category and each of the other body measurements.

In Table 1, only the two temperature increments, "80° F. +" and "60°-70° F.," were tabulated. This was because very few species live at mean annual temperatures lower than 60° F. Furthermore, the measurements of the birds inhabiting the 60°-70° F. regions were

not significantly different from those of the birds living at 70°–80° F. Likewise, the 70°–80° F. birds did not differ significantly from those living at 80° F. +. This was because there was considerable overlap of ranges, many of the birds living at 80° F. + also living in regions of 70°–80° F. mean annual temperature, etc. Hence, the increment 70°–80° F. was omitted.

In the table one may observe that the average total length of the birds living in regions of mean annual temperature 60°–70° F. was 37.7 mm. greater than the average length of those birds inhabiting the hot equatorial regions. The standard error of this difference is somewhat less than three times the difference, hence we may assume that these calculations reveal a fairly significant correlation between temperature and the total length of the birds in a given habitat. However, one must understand that any general consideration of temperature, as in the present work, necessarily leaves much room for error. For example, we have used the mean annual temperature as expressed in terms of broad geographic belts, defined by isotherms. Naturally, in any selected area there is likely to be great deviation from this value, which might render insignificant this mean, as we use it here. Therefore, we must view our temperature data in much the same manner as we do our measurements, i. e., not to be taken too literally.

WING LENGTH OF THE SPECIES OF *Columba*

Because of space limitations, no map is presented here of the variations in wing lengths of the species of *Columba*. However, such a map would have many features in common with Text-figure 2. That is, the smaller wing lengths are found in the equatorial regions of South America and Africa, just as were the smallest total lengths. But it is in South America that the shortest wings occur, the average lengths being less than 180 mm. In equatorial Africa these lengths do not fall below 200 mm., while in the equatorial East Indies the values approach 220 mm. As in the case of the total lengths, the shorter-winged birds most often do not live at great distances north and south of the Equator. Thus, the wing lengths of American species of *Columba* average 174 mm. at the Equator, 209 mm. in the north-western United States, and 210 mm. at the southern end of South America. Similarly, in the Old World the wings are longer in those species at a distance from the Equator than are the wings of the equatorial forms. Between northern Africa and the Arctic Circle the species remain rather constant in respect to their wing lengths, whereas in the New World, in the same latitudes, there is considerable di-

versity. The species inhabiting Japan, Australia, and the islands adjacent thereto possess the greatest wing lengths, just as they possess the greatest total lengths.

Again from Table 1, we may see that the species inhabiting those latitudes where the mean annual temperature is less than 70° F., have wing lengths greater than 220 mm., whereas those species living in hotter regions have their wing lengths reduced to much nearer 200 mm. These figures appear to reveal significant differences. It would seem, therefore, that the wing length, just as the total length, is correlated with temperature. Perhaps we should mention here that there is undoubtedly a high degree of correlation between general body size and size of the appendages. Therefore, the correlation of wing length or tail length, etc., with temperature may be in reality an expression of the correlation of these body parts with the general body size of the bird. In this case, the temperature correlation would be but incidental.

TAIL LENGTH

With regard to tail length of *Columba*, we again find a larger proportion of the small species inhabiting the equatorial regions of South America and Africa. A map featuring the geographic variation of tail length would be quite similar to the map of total length. As we go south of the Equator in Africa and South America, the long-tailed species become more common, the average tail length increasing from less than 110 mm. at the Equator to over 130 mm. at Cape Horn and Cape of Good Hope. Likewise, there are more long-tailed species in North America, the average length being nearly 140 mm. in the state of Washington and southwestern British Columbia. Variations in length are irregular through Europe and western Asia, and the longest-tailed species inhabit eastern China, Japan, Australia, and the adjacent islands. In Table 1, one may observe that the species inhabiting regions of mean annual temperature less than 70° F. have tails exceeding 135 mm. in length, whereas those in regions with mean annual temperature higher than 80° F. have tail lengths less than 128 mm. These differences are hardly significant, and serve only to show a trend.

TARSAL LENGTH

The tarsal lengths show much the same geographic variations as do the previously mentioned measurements, as one may observe in Text-figure 3. Birds in equatorial South America obviously have the shortest tarsi, and those in equatorial Africa have the shortest tarsi of the African and European species. In Australasia the small-

est tarsi occur in Australia, and the longest in all the world are to be found in the birds of the Japanese Islands and the other islands of the western Pacific. A predominance of species with a long tarsus occurs in the Americas and in Africa as distance north and south of the Equator increases. Thus, birds in Venezuela have an average tarsal length of 23.5 mm., whereas the average tarsal length of birds in southern South America is nearly 30 mm. Similar relationships may be observed in North and Central America, Africa, and Europe.

Referring again to Table 1, we see that the birds living in habitats with the mean annual temperature below 70° F. have tarsal lengths averaging more than 29.0 mm., and those living at 80° F. or higher have average tarsal lengths of 25.6. These differences are significant. Consequently, it seems evident that there is a positive correlation between temperature and tarsal length.

CULMEN LENGTH

The geographic variation in the culmen length of *Columba* species is shown in Text-figure 1. It seems evident that the culmen length is not correlated in the same manner as are the other characters, with environmental forces. In only one particular does the culmen-length map agree with the other maps; in all of them the largest species are in Europe and Asia, and the smallest species occur in the Americas. However, when we analyze the species in terms of the mean annual temperature of their habitats, we find that the culmen length varies more or less as do the other factors that have been presented. Thus, in Table 1, we see that the average culmen length at 60°–70° F. is 19.3 mm.; and it decreases to 17.9 mm. at 80°–90° F. These differences, nevertheless, do not have as much statistical significance as do the values for other characters.

An attempt was made to break down the data to include smaller and perhaps more pertinent geographic units. For example, all the species inhabiting the 80° F. + mean-annual-temperature belt in the New World were compared with the species which are found in the 60°–70° F.-temperature belt. Similarly, the European and African species were compared, as well as those of Australasia. For convenience, the species inhabiting the Old World west of the 60th meridian of longitude east of Greenwich were arbitrarily considered in Europe and Africa, while those species to the east of the 60th meridian were considered in Australasia. The more significant data derived from these comparisons are presented below.

Those of the New World species that inhabited regions with temperatures ranging from 80° F. upward, had the following meas-

urements: total length, 327.0 mm.; body, 203.5 mm.; wing, 188.0 mm.; tail, 123.0 mm. The species that lived in the 60°–70° F. regions were always somewhat larger, on the average, their measurements being as follows: total length, 355.3 mm.; body, 256.7 mm.; wing, 201.0 mm.; tail, 127.0 mm. Essentially the same relations were observed among the European and African forms. The species inhabiting the 80° F. + regions had the following measurements: total length, 328.5; body, 208.2; wing, 208.7; tail, 120.3. Those living in the 60°–70° F. region were larger, measuring: total length, 373.0 mm.; body, 233.7; wing, 225.4; tail, 139.3.

Since the number of species included in any one of the geographic units was usually quite small (most often, less than a dozen), it is evident that the differences are of questionable significance. None of the differences found among the species of Australasia was significant; hence their averages are not considered. Of those that are considered, several are of questionable significance. The measurements of which we can be reasonably certain are the total length, wing, and body measurements taken from the New World species. All these measurements reveal that a greater proportion of distinctly larger species inhabit the cooler regions.

ALLEN'S RULE

Are the lengths of the appendages *relatively* smaller, when compared with body size, in the cold than in the hot regions? In order to make an accurate study of this problem, we should have available a reliable body measurement exclusive of feathers. But in the literature such a character is seldom or never reported. 'Total length' and 'tail length,' however, are almost always given. Hence, although one is unable to determine accurately the 'body' lengths of the many species, computed measurements might well show much the same ratios, with reference to Allen's Rule, as would the accurately measured body lengths. With this in mind, the tail length was subtracted from the total length, and the remainder assumed to be approximately the 'body' length. This calculated body length was then compared with the lengths of other parts, with the view to determining whether the derived relations obeyed Allen's Rule. Table 2 presents the ratios of body length to length of other parts. These ratios are arranged in terms of the mean annual temperature of the habitat of the various species measured, just as in Table 1.

In Table 2, one may observe that the culmen of those species inhabiting warmer regions is somewhat longer (relative to body length) than is the culmen of species living in cooler districts. Similarly, the

TABLE 2

| <i>Mean Annual Temperature</i> | <i>Culmen: Body</i> | <i>Wing: Body</i> | <i>Tail: Body</i> | <i>Tarsus: Body</i> |
|--------------------------------|---------------------|-------------------|-------------------|---------------------|
| 50°-60° F. | .081 : 1.000 | .95 : 1.00 | .59 : 1.00 | .125 : 1.000 |
| 60°-70° F. | .083 : 1.000 | .95 : 1.00 | .59 : 1.00 | .125 : 1.000 |
| 70°-80° F. | .085 : 1.000 | .96 : 1.00 | .62 : 1.00 | .124 : 1.000 |
| 80°-90° F. | .085 : 1.000 | .96 : 1.00 | .60 : 1.00 | .121 : 1.000 |

wing and tail lengths are relatively greater in warmer than in cooler regions. Tarsal length, however, apparently varies in the opposite direction, the relative length of the tarsi being greater in cool climates. In all these ratios, the differences are small, and their statistical significance questionable. Therefore, these data do not appear adequate to confirm Allen's Rule.

OTHER GEOGRAPHIC VARIATION GRADIENTS

Another directional variation may be observed in this genus, which does not coincide with any climatic gradient that the author is able to recognize. In earlier sections mention has been made of the tendency of the American species to be smaller than the European, African, or Australasian forms. Especially large are the forms along the eastern coast of China and in the nearby islands of the Pacific. If we arrange our measurements in three categories—(1) Australasia, (2) Europe and Africa, and (3) New World—we find a graded series from east to west.

Table 3 presents averages of the several measurements, arranged in terms of the habitat of the various species in one of the three regions mentioned above. There is a distinct increase in size as we proceed east from the Americas. Thus, in average total length, the birds

TABLE 3

| <i>Geographic location</i> | <i>Total length</i> | <i>Body length (computed)</i> | <i>Wing length</i> | <i>Tail length</i> | <i>Tarsus length</i> | <i>Culmen length</i> |
|----------------------------|---------------------|-------------------------------|--------------------|--------------------|----------------------|----------------------|
| <i>New World</i> | 332.0 | 206.7 | 189.0 | 126.0 | 25.6 | 16.3 |
| <i>Europe and Africa</i> | 342.0 | 210.3 | 212.0 | 131.0 | 27.5 | 20.1 |
| <i>Australasia</i> | 380.0 | 233.2 | 227.0 | 146.0 | 28.5 | 19.1 |

increase from 332 mm. in the Americas to 342 mm. in Europe and Africa, and thence to 380 mm. in Asia—a total increase of 13%. Similarly, the average wing length of New World species is 189 mm.

while in European and African forms it is 212 mm., and in Asiatic species it has increased to 227 mm.—a total increase of 17%. In practically all these measurements, the differences between the New World species and those of Europe and Africa are of questionable significance, whereas the differences between the Australasian forms and those either of the New World or of Europe and Africa have significance. The culmen length is the only morphologic factor herein considered in which there is not a steady increase in length as we go from west to east, from America to Asia. In the case of the culmen, the greatest average length appears in the European and African species, although the difference between these and the Asiatic forms certainly is not great and is insignificant.

There are yet other features in the figures that deserve mention. The species that occur in Mongolia, East Turkestan, and Tibet seem to be somewhat smaller, on the average, than the birds in adjacent regions in any direction. This feature may be observed to some extent in any of the several maps, particularly Text-figure 2, which relates to the total length of the species. There are only eight species of *Columba* in these regions, some of which are restricted to this region, while others range westward to the British Isles. Unless these species have adapted themselves to the aridity that characterizes the region of the Gobi Desert, it is difficult to explain why they should be smaller here than to the west, east, and southeast. It is possible that they have become so adapted. Some of the driest regions in the world are to be found in the belt of country extending from the western edge of the Sahara eastward to the Red Sea, thence through Arabia, on northeastward into the Trans-Caspian regions, and finally into the Gobi Desert. From the Caspian Sea westward across Europe, the mean annual precipitation increases more or less steadily.

Comparing these precipitation differences with size differences in the species of *Columba*, we find small species in the Gobi Desert region, and as we proceed from this vicinity westward toward Europe, into more humid countries, the birds have longer wings, tarsi, tails, culmens, and total lengths. To the east of the Gobi, in the humid regions along the Chinese coast and in the islands of Japan, the species generally are of larger dimensions. These observations are insufficient, of course, to enable us to draw any definite conclusions. All that can be said is that there is a possible correlation between precipitation and size differences in the genus *Columba*. More extended studies are needed to elucidate this correlation.

In some regions, there is great variability in size, while in others

the average measurements of species are much the same over wide areas. Thus, the average wing length increases from less than 180 mm. in the vicinity of Panama to over 200 mm. in northern Mexico. This is a relatively abrupt change and is quite different from the gradient in Europe and western Asia, where the wing length remains quite constant. No satisfactory explanation can be given for these differences in geographic variability, since there are no recognizable geographic gradients that could be applied here.

DISCUSSION

Several explanations have been offered for Bergmann's and Allen's rules. Reinig has suggested that variation gradients are associated with species dispersion and that genetic factors have dropped out of the gene complex of the species during the dispersion process (see Huxley for discussion of Reinig's views). This explanation hardly accords with the concept of Rensch, who believes the size-variation gradients of animals to be adaptively correlated with environmental gradients. Certainly there is abundant evidence in favor of Rensch's analysis, whereas Reinig's hypothesis is difficult to entertain. Dobzhansky has considered the view that Bergmann's Rule is concerned with the temperature regulation of the animal—that is, a large body size is correlated with a *relatively* smaller body surface, and vice versa. In a cool region, it would perhaps be to an animal's advantage to have a relatively smaller body surface, because this would enable the animal to have a more limited loss of heat. In a warm country, the small-bodied species would exhibit relatively greater body surface and thereby experience greater heat loss. This would seem especially desirable in the exceptionally humid regions along the Equator in South America and Africa, and it is in these places that the smallest birds, with the relatively largest body surfaces, are to be found. This might be a reasonable view, except for the fact that most of the measurements employed in this study are measurements of feather length. These are dead structures and certainly do not have the heat regulatory function of the tail, let us say, of mammals. Therefore, it is difficult to see just how this explanation would apply. Furthermore, the species of *Columba* that inhabit the colder regions often migrate toward warmer regions during the winter months, whereas many of the species near the Equator are more restricted in their ranges. The value of longer feathers as heat regulators is accordingly open to question.

From Table 3 it is evident that there is a large-scale size-variation gradient correlated with the continents, the New World species being

smaller than European and African forms, and these, in turn, smaller than the Asiatic birds.

CONCLUSIONS

A study of the species of genus *Columba* suggests that a greater proportion of the species having shorter average total length, wing length, tail length, and tarsal length, inhabit the warmer regions of the earth. In the cooler regions there is a preponderance of the large forms. Thus, Bergmann's Rule, or more likely a modification thereof, may be applied to the species of genus *Columba*. Allen's Rule cannot be confirmed by these data. Evolution within the genus *Columba*, in the characteristics studied, appears to have proceeded primarily from south to north or vice versa, though with some evidence of progressive differentiation from east to west.

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A GROSS STUDY OF THE BURSA OF FABRICIUS AND COCK SPURS AS AGE INDICATORS IN THE RING-NECKED PHEASANT

BY J. P. LINDUSKA

Plate II

THE accurate establishment of age groups of animals is an important phase of many ecological studies. In experimental management programs whose prime consideration is to measure yearly population trends, the ability to distinguish age classes has a special significance. It is often possible from an analysis of a fall population to make some evaluation of the extent of the previous spring and summer breeding and the subsequent survival of young.

In the case of game species, autumn hunting often results in the kill of a large percentage of the total population. Conservation officers' road blockades, managed hunting areas, etc., provide situations which make possible brief examination of significantly large numbers of these animals. Where techniques are available which permit rapid interpretation of various characters and conditions, considerable valuable information is obtainable from these sources.

At the Rose Lake Wildlife Experiment Station, Clinton County, Michigan, the Game Division has in progress a long-term study on the management of farm wildlife. On this area, extensive year-round observations culminate in a carefully measured and studied fall harvest of pheasants (*Phasianus colchicus torquatus*), rabbits (*Sylvilagus floridanus mearnsii*), and fox squirrels (*Sciurus niger rufiventer*) from 1500–2000 acres of farmland. The hunting is conducted under a managed plan which requires that all participants keep individual hunting records and submit all game taken to the station laboratory for examination. This system, in effect for two years, has made possible the examination of reasonably large samples of the several game species. As a result of these examinations and certain incidental studies, data have been obtained which have resulted in simplified methods for rapid age determination of pheasants by external means. These techniques utilize spur conditions in males, and the bursa of Fabricius in either sex.

The value of the bursa as a means of distinguishing adult from juvenile game birds was first recognized by Gower (1939). The technique as reported depended upon dissection for demonstration. It was consequently not suited to the rapid handling of a large series of dead birds and, of course, was not usable on living birds. As mentioned by Gower, these points constituted the principal limitations.

The increased spur length of cock pheasants, while generally recognized as being indicative of old birds, has apparently not been sufficiently investigated to establish its real value as a criterion of age.

The hunting-season data here compiled were obtained through the coöperative efforts of a number of former members of the Rose Lake staff to whom grateful acknowledgement is made. Of these, Charles T. Black, who supervised study of the 1940 hunting-season kill of pheasants, deserves special mention. Others who contributed to the study include Philip S. Baumgras and Warren W. Shapton in the 1940 hunting season, and Howard D. McGinley, Frank R. Martin, and Clare File in the 1941 season.

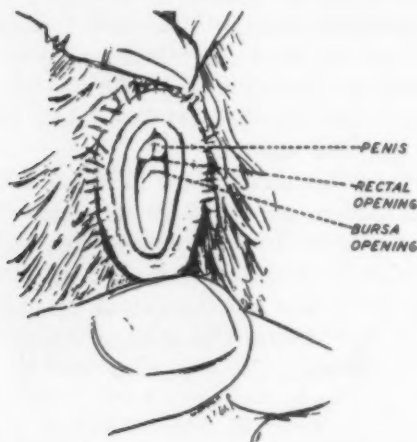
I wish particularly to thank Durward L. Allen, Biologist in charge of the Rose Lake Station, for his help and advice throughout the study. The work on game-farm birds was facilitated through the coöperation and interest of game-farm Superintendent Walter Van Dien and members of his staff. Assistance in making statistical computations was given by Miriam Geboo; the sketch shown in Text-figure 1 is by Oscar Warbach.

BURSA OF FABRICIUS

At its height of development in the pheasant, the bursa is a thick-walled, sac-like structure, approximately 20–30 mm. in length, and lying dorsal to, and at the extreme posterior end of, the large intestine. The full function of the organ is obscure; it has been recognized that the bursa consists largely of lymphoid tissue, and that it operates in a hematopoietic manner. However, various considerations point to it as being primarily of endocrine function. The fact that it exhibits its greatest development at the beginning of division of the sex cells and disappears coincident with sexual maturation (Jolly, 1915) makes it available as an age determiner. The structure, when present, may be easily and rapidly viewed in dead pheasants by making a lateral incision into the coelom at a point about half an inch behind the posterior margin of the cloacal fringe. Drawing the large intestine part way through the opening will then reveal the bursa. The works of Jolly (1915), Boyden (1922), and Gower (1939) give more detailed consideration to the structure.

Determining the age of pheasants without dissection is accomplished by probing the bursa through its opening, which is located on the dorsal median surface of the cloaca (Text-fig. 1). Until some familiarity with the exact position of the opening is obtained, its location in dead birds will be facilitated if the lateral walls of the cloaca are slit and the posterior margin laid back (Plate 11, left

figure). As an instrument for probing, particularly in living birds, an 8-penny nail on which the point has been rounded, has been found entirely satisfactory. Since, as will be shown later, an instance may occasionally arise in which an approximation of the extent of the bursa is desirable, calibrating the nail at 5 mm. intervals is convenient.



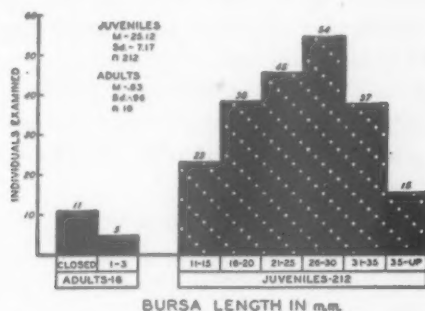
TEXT-FIGURE 1.—Ventral view showing the dorsal wall of the cloaca. The bursa opening lies just posterior to the rectal aperture. Sketch is from a live bird in breeding condition. The penis (anterior) is inconspicuous except during the breeding period. Compare with Plate 11 (left figure).

OBSERVATIONS ON WILD BIRDS

In the period September, 1940, to June, 1942, nearly 2000 individual pheasants were available for examination and study. Of these, 1353 were fall-shot cock birds examined on conservation officers' blockades; 403 were fall cocks shot on the Rose Lake controlled hunting area and examined in the station laboratory; and nearly 200 others were available from live-trapping operations.

As one result of these examinations it was noted that the cloacal opening of the bursa is present in all young of the year. However, this in itself was found not to be a completely reliable indication of juvenility in fall birds since nearly one-third of the adult cocks (over one year old) examined during the hunting season also had a vestige of the bursa persisting with a plainly visible opening. Confirmation of age in these individuals was at the time made by dissecting for the bursa proper. Over two-thirds of the autumn adults had the opening entirely sealed and nearly 90 per cent of the juveniles examined had a bursa measurement of over 16 mm. (Text-fig. 2).

Consequently, in the fall most adults are immediately recognizable by the lack of a bursa opening in the cloaca, whereas all juveniles are characterized by the presence of this same aperture. In the few atypical individuals that have been examined, a workable margin still remained which allowed accurate aging by measurement. In adults in which the bursa opening persisted, the bursa remnant was extremely short, measuring 3 mm. or less, whereas no juveniles were observed in the fall having a bursa shorter than 10 mm., and most had bursa measurements of 16–40 mm.



TEXT-FIGURE 2.—Frequency distribution of 228 bursa measurements obtained from cock pheasants shot in the 1941 hunting season and examined at the Rose Lake Wildlife Experiment Station laboratory. Standard deviations given above and those appearing elsewhere in the text or figures have been calculated from grouped series of measurements and are not adjusted.

STUDIES ON CAPTIVE PHEASANTS

In order to determine definitely the length of time during which the bursa is indicative of age, a series of examinations was made at approximately regular intervals on captive birds. These animals of known age were confined in open-range pens. Similar observations were made on a few wild-banded individuals recaptured by live-trapping, and periodic autopsy of a limited number of others was also made to check the gross condition of the bursa and the reproductive system at various times of the year.

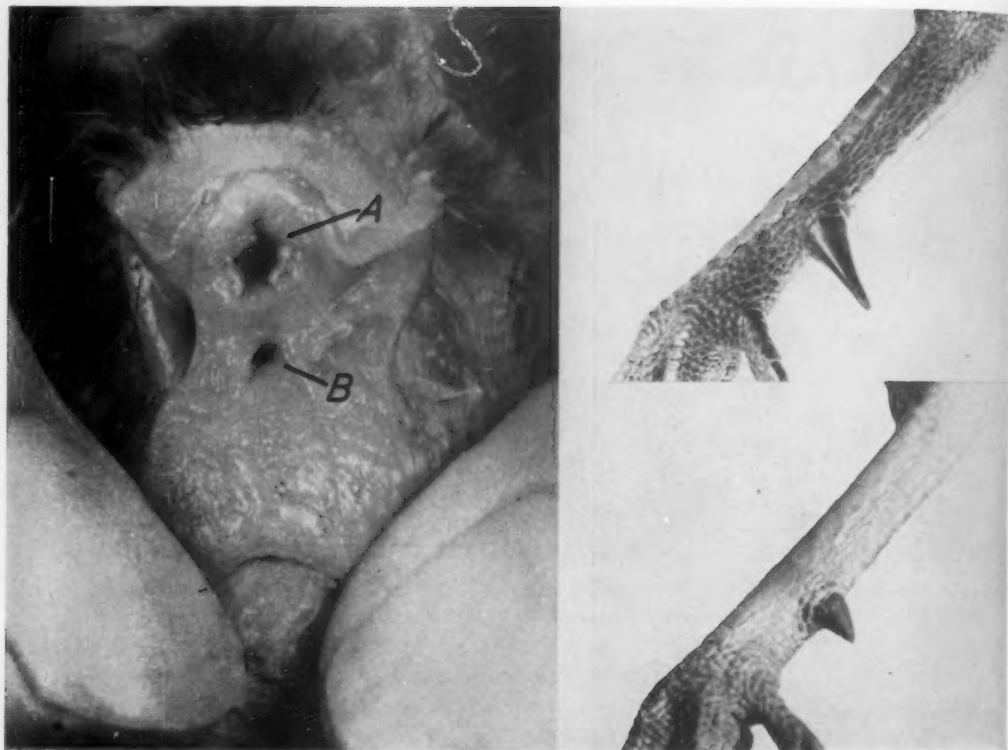
The captive birds used in the study were game-farm stock hatched in the spring of 1941. About sixty individuals of each sex were confined late in December, 1941, and monthly observations were made on most of these until May, 1942. The actual numbers examined and dates of examination are shown in Text-figure 2. The interval between examinations was extended to several weeks in order to preclude any possibility of the bursa remaining open as a result of

too frequent probing. That such did not occur is indicated by the fact that a new series of birds examined in early May showed practically the same condition as regards closure of the bursa as did the study group.

Due to differences in feed, activity, etc., there existed the possibility that the game-farm birds used in the study would not have developmental rates the same as wild birds. This was further suggested by the fact that evidences of sexual maturity were noted among the captives somewhat earlier than among wild birds. It is doubtful, however, that differences in the rate of bursa disappearance between captive and wild birds was appreciable. Sufficiently large numbers of wild-trapped birds were not available through the entire study to observe whether or not differences did exist, but in a series of thirty January hens taken by live-trapping, the average bursa measurement was found to be practically identical with that found for game-farm birds at about the same period.

The bursa proper was easily recognizable by dissection in early December pheasants (both wild and captive), but the structure could be distinguished only with difficulty in the few late January and early February captive specimens which were examined. The remnant of the bursa was at this later date membranous in appearance, and could be distinguished from surrounding mesenteries only by probing through the cloacal opening and following the path of the probe. On the basis of these examinations it appeared that, after early January, judging age solely by dissection for the bursa would require careful interpretation. Although recognition of the bursa proper was difficult in the few birds examined in January and early February, the membranous vestige and its opening into the cloaca continued evident by probing for another two to three months in most specimens. A series of monthly observations on captives for the period January to May, showed that the opening into the cloaca was still present in all birds in February. However, the length was found to be less than 5 mm. in a few cocks by the middle of January and in several hens by a month later.

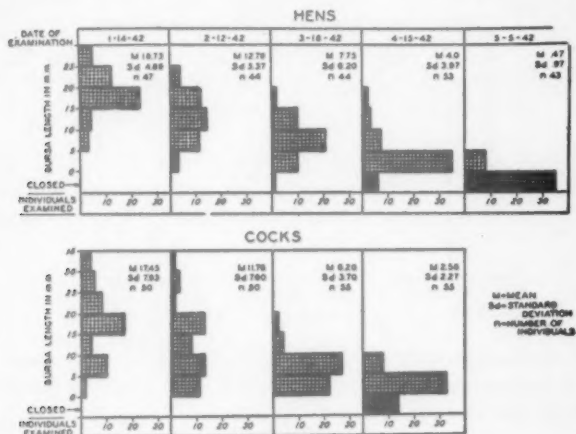
It was found (Text-fig. 2) that remnants of the bursa may persist in males over a year old, at least until the fall of their second year. Sufficient numbers of these old birds were not available for study to determine to what extent the bursa may close during the second winter. That it may remain open in some, however, was shown from the trapping record of cock E 9167. This wild bird, a juvenile of 1940, was first trapped and banded September 25, 1940. No subsequent



(Left) VENTRAL VIEW OF THE DORSAL WALL OF THE CLOACA IN A NON-BREEDING COCK PHEASANT. THE LATERAL WALLS HAVE BEEN SLIT AND THE POSTERIOR MARGIN LAID BACK. RECTAL OPENING IS AT A; BURSA OPENING AT B. (Right, upper) SPUR OF ADULT COCK (OVER ONE YEAR OLD) IN THE FALL. NOTE LENGTH, SHAPE, DARKNESS OF COLOR, AND HIGH GLOSS. (Right, lower) SPUR OF JUVENILE COCK (BIRD OF THE YEAR). THIS PHOTOGRAPH WAS TAKEN IN FEBRUARY AND SOME DARKENING OF THE SPUR IS ALREADY APPARENT.

handlings were made until April 9, 1942, when it was found that a vestige of the bursa still remained. The bird was a year and nine or ten months old at the time.

The persistence of the externally visible opening in old individuals undoubtedly is exceptional, but since a small percentage of juveniles can also be found in late winter in which the bursa has declined to a remnant, there exists a small group which cannot be distinguished on the basis of length of bursa alone. It was found (Text-fig. 3)

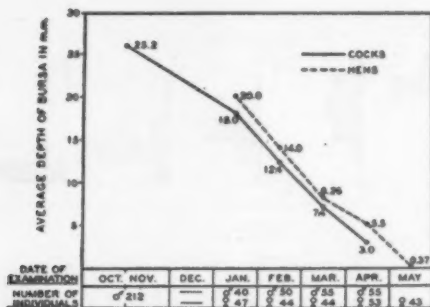


TEXT-FIGURE 3.—Distribution of bursa measurements of captive birds examined at approximately monthly intervals through winter and spring. Complete closure of the bursa was noted in some hens by mid-March and in cocks by mid-April.

that at least a portion of the bursa was still present in all yearling hens during February, and in all yearling cocks until March. Also, to the middle of March, a substantial majority of both sexes still had ducts over 5 mm. in length. From these notes it is indicated that in early spring most adults are characterized by a completely closed duct, and most of the yearlings by the presence of a bursa over 5 mm. in extent. Consequently, it should still be possible to distinguish most yearling birds from adults over a year old as late as March.

The average rate of closure of the bursa through winter and early spring appears as a uniform progression (Text-fig. 4). The banding of all animals at the first examination made it possible to follow the same process in individuals, and while a similar gradual shortening of the bursa was found for most birds, it was not true in all cases. A few exhibited extreme conditions of closing rapidly over a short period of time, while in others the bursa shortened comparatively

little over a two- or three-month period. In hens the bursa consistently averaged slightly longer than in cocks and the closure of this structure and its cloacal opening in females, while uniformly slower, was more complete. A July, 1942, examination of 1941 birds showed the cloacal opening of the bursa to be still present even though extremely shallow (less than 5 mm.) in six of twenty-five cocks, whereas a complete closure and healing over of the opening was noted in all twenty-five hens examined.

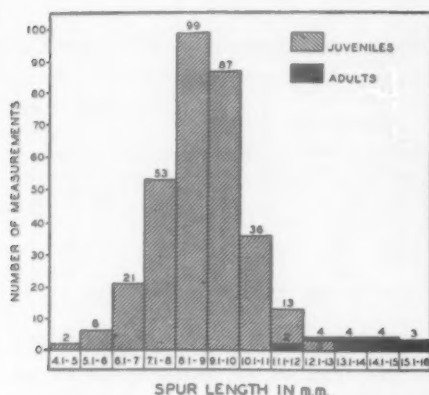


TEXT-FIGURE 4.—Average rate of closure of the bursa in both sexes. October-November, 1941, measurements were taken from fall-shot cocks; the January through May, 1942, measurements were from live captives.

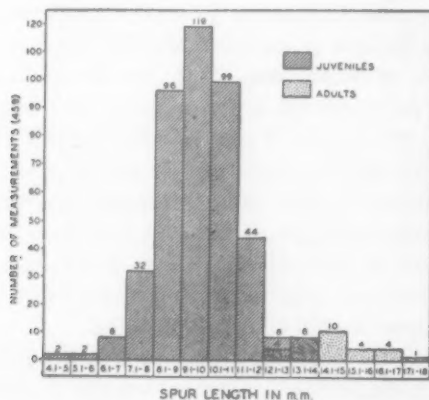
SPUR LENGTH IN COCKS

Although length, texture, and color of cock spurs are occasionally considered in estimating age of domestic fowls, the structure has apparently not been widely used in aging game birds. The following information, based on 796 spur measurements taken in the fall of the year, together with cursory examination of nearly 1400 additional fall-shot birds, indicates that spur length by itself is of value at this season, and when considered in connection with other spur characters, age distinctions are possible for most cocks in the autumn.

The general distribution of juvenile and adult spur lengths in the fall of the year is shown in Text-figures 5 and 6. Although there is some overlap between maximum juvenile lengths and minimum adult lengths, the nodes of the two groups are distinct and indicate that accurate age determination should be possible for many individuals on the basis of spur length alone. In the 1940 kill of cocks at Rose Lake, 88 per cent of the adult spur measurements were greater than 12 mm. and 95 per cent of the juvenile spurs were 11 mm. or less in length. The 1941 kill showed 87 per cent of all adult spurs to be over 13 mm., whereas 94 per cent of all spur measurements for young



TEXT-FIGURE 5.—Frequency distribution of adult and juvenile spur measurements in the fall of 1940. Overlap between maximum spur lengths of juveniles and minimum spur lengths of adults was found to be slight.



TEXT-FIGURE 6.—Frequency distribution of spur measurements taken from adult and juvenile cock birds shot in the fall of 1941.

birds were 12 mm. or under. Statistical analysis of this series of measurements for the two years showed the results to be highly significant. The average and extreme measurements of both age classes for two years are given in Table 1.

It can be shown statistically that on a curve of normal distribution, 99.7 per cent of all cases will fall within limits set by three standard deviations of the mean. Applying this to the groups of data shown in Table 1 (also Text-figs. 5 and 6) it is found that in 1940 the lower limit of adult spur measurements (three standard deviations

TABLE 1
AVERAGE AND EXTREME SPUR LENGTHS OF FALL-SHOT COCK PHEASANTS

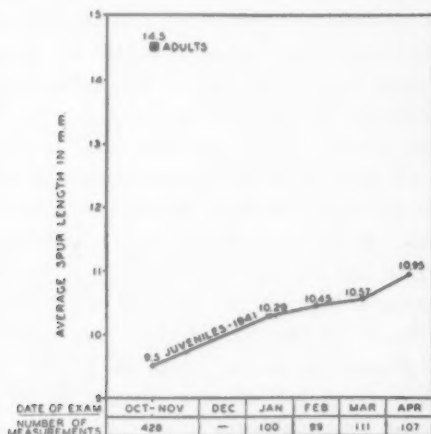
| Year | Age Class | Number of Measurements | Spur length in mm. | | | s. d. |
|------|-----------|------------------------|--------------------|---------|------|-------|
| | | | Maximum | Minimum | Mean | |
| 1940 | Adult | 17 | 15.9 | 11.0 | 13.6 | 1.32 |
| | Juv. | 320 | 12.3 | 4.3 | 8.9 | 1.36 |
| 1941 | Adult | 31 | 17.0 | 12.0 | 14.1 | 1.33 |
| | Juv. | 428 | 13.2 | 4.5 | 9.5 | 1.48 |

below the mean) is 9.74 mm. On the basis of the above series of measurements, 99.7 per cent of all adult spurs in an infinite sample would theoretically fall above the limits of 9.74 mm. The extreme upper limit of juvenile spur measurements is, on this same basis, found to be 12.88 mm. for an infinite sample. Since practically all adult spurs would be greater than 9.74 mm., it follows that any measurement below that would indicate a juvenile. All (99.7 per cent) of the juveniles in an infinite population should theoretically fall below the extreme length of 12.88 mm., and, conversely, any spur length falling above that point would be an adult. The zone encompassed by the lengths 9.74 mm. to 12.88 mm. would, statistically, nearly completely cover the overlap of age groups in an infinite population. A similar statistical manipulation of measurements, taken the year following, establishes the lower limit of adult spur lengths at 10.51 mm. and the upper limit of juvenile length at 14.14 mm. In this case, practically all individuals with spurs less than 10.51 mm. would be juveniles and all those over 14.14 mm., adults.

It is evident from the foregoing that cock birds in the fall of the year form mutually exclusive age groups on the basis of spur length alone. However, the differences in average length of spur found for the same age classes in the two years makes apparent a source of error that might be encountered in attempting to formulate indices by which age distinctions for all birds could be made in any given year. The rate and extent of spur development quite possibly are affected by geographical, and almost certainly by yearly climatic, differences. An example of the apparent effects of the latter is to be seen in the smaller average and extreme spur lengths recorded in 1940 (Text-figs. 5 and 6, and Table 1). Some factor or combination of factors which caused a slight postponement of nesting or considerable reneating in the summer of 1940 resulted in many unusually young juveniles being present on this area in the fall. Nu-

merous birds were examined in the fall of 1940 that had not completed the post-juvinal molt, whereas in the fall of 1941 nearly all cocks shot were in fully adult plumage. The presence of these younger birds in 1940 appears in this case to be reflected in the record of spur measurements for that year.

In addition to length alone, certain other characteristics of spur color and texture also serve well to help distinguish young and old males in the fall and early winter. The handling of a good series of animals in both age groups will show that aside from differences



TEXT-FIGURE 7.—Growth rate of juvenile spurs through the first winter. October–November measurements taken from fall-shot cocks; December through April figures from captives.

in length, practically all adult spurs are further characterized by being very dark in color, acutely pointed and sharp, often decurved, and with a hard, glossy surface (Plate 11, upper right figure). Juvenile males in the fall and through the winter have spurs that are most often straight along the edges, with points more obtuse, and with the surface (in the fall) much lighter in color and softer than in the adults, and without luster (Plate 11, lower right figure).

Studies on spur development, using a series of captive juvenile birds, indicated the process to be gradual with a possible slight acceleration of growth in early spring coincident with sexual maturation and mating (Text-fig. 7). By the middle of January the spurs of a few individuals had begun to assume the characteristic adult appearance, and by the latter part of April about half of them looked like adult spurs but had not reached the size found for the

average fall adult. As late as early May, over half of the birds studied could still be recognized as juveniles of the year previous on the basis of spur length. Thirty of fifty-four males handled at this time had spurs under 11 mm., or smaller than the shortest adult spur found in the fall of the two previous years.

SUMMARY

Methods for the fall aging of either living or dead pheasants by relatively simple means are described. An evaluation of these techniques which utilize the bursa of Fabricius in either sex, and the length and appearance of spurs in the males, can be summarized as follows:

The bursa of Fabricius was found to persist in all juvenile pheasants (birds of the year) into December. The occurrence of this structure indicates juvenility and its presence can be verified by probing through its opening in the dorsal median wall of the cloaca. The bursa is absent in all birds over one year old and in this study its absence was indicated in most adults by the fact that the former opening into the cloaca was completely grown over. Although the opening and a small vestige of the bursa were noted in a few old birds, these could easily be distinguished on the basis of the comparative lengths of the bursa remnant. In the fall of the year, adults in which the opening remained showed a bursa depth of 3 mm. or less, whereas probing revealed a bursa depth of over 16 mm. in 90 per cent of the juveniles and in none under 10 mm.

Monthly examinations of captive birds indicated that the bursa opening was still present in all juveniles in February. However, the length of the duct had been reduced to less than 5 mm. in a few cocks by January and a few hens by February. Consequently, a small minority of the juveniles had, by these dates, approached a condition similar to that found in fall adults. This condition would nullify attempts to make age determinations for a few birds after January by using this criterion alone.

The length, shape, texture, and color of spurs were observed to be sufficiently different between young and old birds in the fall to permit accurate aging of practically all cocks. Spur length in itself was found to serve as an indicator of age for many fall birds. Some overlap was found between a few minimum adult measurements and maximum juvenile measurements in both years of the study. Similarly, the average spur lengths for given age groups was found variable in different years. Consequently, age determination, using spur length alone, should be done with some circumspection and doubtful specimens checked by reference to other characters. Additional spur con-

ditions which were found to be distinctive for each age group, and which should be considered, are the shape, color, and texture.

It is our experience in Michigan that, as late as January, age recognition is possible for fully three-fourths of the cock birds by noting spur characters alone. The presumed ages of doubtful specimens may be easily verified by reference to the bursa, which can be probed through its opening into the cloaca. Aging of all hens was found possible into January, the juveniles being characterized by a bursa depth greater than 5 mm.

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GENERAL NOTES

Relative distribution of Mallard and Black Duck in winter.—The material in the first forty-year period (1900–1939) of the Bird-Lore Christmas censuses is well suited for illustrating the relative distribution of the two closely related ducks, the Mallard and Black Duck. I have tabulated the reports for these species on the basis of birds-per-hour of censusing in each state during the period. The ratios between the species are derived from the average birds-per-hour figures for each state by dividing Black Duck figures by Mallard figures where Black Ducks outnumber Mallards, and Mallard figures by Black Duck figures where the opposite is the case. This process reduces the ratio to a basis of unity for the outnumbered species.

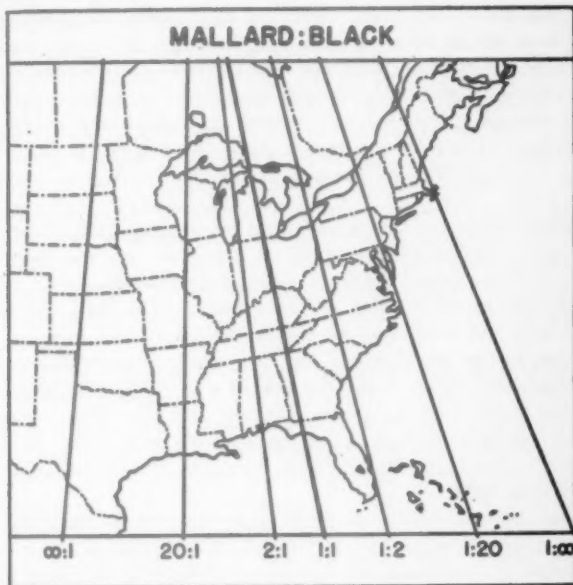
Because the habits of the two species are so similar, it appears unlikely that either species was reported in undue proportions—as conceivably could be true for species of widely divergent habits or habitat selection. There is the possibility, however, that female Mallards were misidentified for Black Ducks and *vice versa*, but the probabilities are that any errors in one direction compensated any in the other in the central region of overlapping ranges. The result on either side of this region presumably would be to increase the apparent proportion of the less-abundant species, for observers tend to identify a commoner species as a less-common one more often than the reverse. In any event, this would influence only the apparent *rate* of change to any extent. The general pattern would remain substantially the same.

The ratio varies from a high of 153.04 Black Ducks to one Mallard in Rhode Island on the eastern edge of the Mallard range, to a high of 590.67 Mallards to one Black Duck in Minnesota on the western edge of the Black Duck range (Table 1).

TABLE 1
MALLARD-BLACK DUCK WINTER RATIO OF ABUNDANCE (1900–1939)

| | Mallard | Black Duck | | Mallard | Black Duck |
|----------------|---------|------------|--------------|---------|------------|
| Massachusetts | 1 | 138.25 | Michigan | 1 | 2.54 |
| Connecticut | 1 | 16.59 | Ohio | 1 | 2.02 |
| Rhode Island | 1 | 153.04 | Kentucky | 5.53 | 1 |
| New York | 1 | 24.78 | Tennessee | 4.14 | 1 |
| Pennsylvania | 1 | 20.69 | Mississippi | 5.87 | 1 |
| New Jersey | 1 | 119.60 | Louisiana | 12.22 | 1 |
| Delaware | 1 | 107.89 | Texas | 116.95 | 1 |
| Maryland | 1 | 15.90 | Wisconsin | 8.89 | 1 |
| Virginia | 1 | 2.08 | Indiana | 3.68 | 1 |
| West Virginia | 1 | 7.34 | Illinois | 10.74 | 1 |
| North Carolina | 1 | 9.13 | Minnesota | 590.67 | 1 |
| South Carolina | 1 | 2.49 | Iowa | 466.13 | 1 |
| Georgia | 1 | 2.40 | South Dakota | 475.99 | 1 |
| Florida | 1 | 1.94 | Missouri | 143.00 | 1 |
| Alabama | — | — | Arkansas | 304.30 | 1 |
| Ontario | 1 | 39.23 | | | |

The ratios have been mapped and lines drawn to indicate the areas of relative change (Text-figure 1). The two species are about equally abundant along a line reaching from Michigan to Florida. (Although lines are used for illustrative purposes, it must be remembered that these lines actually indicate zones of change.) East of this line, the Mallard declines rapidly in relative abundance and reaches a ratio of one Mallard to two Black Ducks, then one Mallard to twenty Black



TEXT-FIGURE 1.—The ratio lines indicate zones of change in the relative abundance of Mallard and Black ducks; they are not fixed boundaries of change. The ratio varies from an "infinite number" of Mallards to one Black Duck, to one Mallard to an "infinite number" of Blacks.

Ducks, and finally one Mallard to an "infinite" number of Black Ducks. The reverse of this is true to the west of the even-distribution line, but the Blacks drop out more rapidly than the Mallards did to the east as evidenced by the closer approach of the lines of 2:1 and 20:1, respectively. The distance between the 20:1 and *infinity*:1 lines is accounted for by the greater opportunity for Black stragglers in the interior than for Mallard stragglers in the Far East.—LEONARD WING, *The State College of Washington, Pullman, Washington*.

Is the Starling population decreasing in northeastern United States?—For about 15 years the Starling has been the most abundant bird in northeastern United States. Accurate counts of such an abundant, gregarious, and active species are almost impossible. Because of their filthy roosting and flocking habits, these exotics have become most obnoxious, especially in the District of Columbia, where the birds have wintered in staggering numbers. Although no exact figures can be given, it seems evident that peak numbers were reached six or eight years ago, a small but noticeable decline taking place each succeeding year.

Better evidence of this decline is found in the agricultural districts of extreme western New York, where serious depredations upon cherry orchards have been experienced. From June 20 to July 3, 1932, the writer studied bird-depredation problems in Chautauqua County, near Lake Erie, in western New York. At this time most of the young birds had been produced and flocks were just forming, but even this early in the summer a number of flocks were seen in the cherry orchards, where damage to the ripened fruit ranged anywhere from practically 0 to 100 per cent of loss upon individual trees. In the course of approximately thirty minutes one morning, a flock of almost a thousand birds descended upon one tree and completely stripped it of marketable fruit. The writer estimated that there were between 15,000 and 30,000 birds roosting on an isolated two and one-half acre site that obviously accommodated a large percentage of the birds in this section of the county. The nesting season was just drawing to a close, so that recruits were joining this flock daily. Needless to say, serious loss in the cherry crop resulted that year.

A similar study was begun in the same area on June 22, 1942, by Mr. Ford Wilke of the Fish and Wildlife Service Research Division, but the investigation was terminated on June 29 because of a relatively small population of birds and consequently small damage to cherries or other crops. The large concentrations of former years were not seen, and the flocks feeding in the orchards were small, numbering from four or five to fifty birds. According to Mr. Wilke and the County Agricultural Extension Agent (who had assisted with both investigations), the large flocks of earlier years were no longer forming and the cherry growers had experienced only minor depredations during the past two years. It was doubtful whether, in the summer of 1942, the area contained 25 per cent of the concentration found there in 1932.

A similar but less noticeable reduction of the enormous wintering flocks is believed to have occurred in the District of Columbia region, although the birds are still overabundant and constitute an annoyance of major proportions in the Capital City. No careful study of populations has been made, but a number of competent ornithologists who have been connected with the Starling problem for many years have repeatedly expressed their belief that there has been an encouraging reduction in the size and number of these flocks. The writer is of the opinion that there has been a reduction of 15 to 25 per cent in the population wintering in this section during the past eight years.

The evidence indicates, also, that there has been a general reduction in their numbers throughout much of the northeastern part of this country, especially in the section east of the Alleghenies and north of central Virginia. There can be little doubt, however, that there has been a progressive increase in their numbers and an extension of their range in the South and Far West.

A study of Starling populations throughout the country at this time would seem most desirable. Is the species declining in population? If so, what factors are responsible? What are the results of this shift or reduction in population? Are competitive species increasing? How does the shift in population compare with that of the introduced House Sparrow? Comments from other bird students are solicited.—CLARENCE COTTAM, *Fish and Wildlife Service, Chicago, Illinois.*

The occurrence of feather impressions in the Miocene deposits of Maryland.—On April 20, 1941, Roland W. Brown and William E. Salter of the U. S. Geological Survey while examining the cliffs along the western shore of Chesapeake

Bay near the mouth of Parker's Creek, at the northern end of Scientists' Cliffs, Maryland, secured a fragment of coprolite approximately 60 mm. in diameter and the same in length. The specimen is irregular in shape, being roughly rounded, with one side flattened and the ends broken. The broken ends show small, striated areas that gave rise to careful examination by Dr. Brown and Mr. Lloyd G. Henbest who determined that these were parts of feathers, so that the specimen came to my hands for further study.

The entire mass is well fossilized though somewhat brittle. Numerous parts of feathers are exposed on the broken ends and others show in a fracture where a thin piece has been split off one side. The shafts and the vane structure in some are exceptionally well preserved so that there is no doubt as to their identity. Feather impressions are found clear to the center of the coprolite, indicating that they are scattered through it in considerable number. The individual feathers examined seem to be contour feathers, mainly of medium size, with the close web characteristic of aquatic birds; several show strongly ridged barbs and in several the finer lines of the barbs are evident under slight magnification.

The impressions of feathers have been recorded from various localities and ages but so far as I am aware have not been reported previously from a coprolite. The assumption must be that this particular fragment comes from a large fish or a crocodile, both being found in the deposits in question. It appears that the birds of the Miocene had savage enemies in the water as do their descendants today.

The actual location of the find, from data supplied by Mr. Salter, is approximately 540 feet south of the mouth of Parker Creek, or on the first cliff to the south of that point, about 40 feet from the northern end. The fossil was exposed on a little bench in a gray-green sandy clay that overlies a broad exposure of compact, bluish, sandy clay. Dr. Remington Kellogg, who has studied these exposures in detail, informs me that this would place the location of the fossil in zone 12 of the Calvert Miocene, the blue clay below being in zone 11.

The specimen has been presented to the U. S. National Museum, and bears the catalog number 16,738.—ALEXANDER WETMORE, *U. S. National Museum, Washington, D. C.*

Notes on the birds of western North and South Dakota.—During an automobile trip westward through South Dakota on June 3 and 4, 1942, then northward and eastward through North Dakota on June 5 to 13, we made a number of brief stops for ornithological surveys in regions adjacent to the highway. Although the results were mainly of personal interest (acquaintances with species hitherto unknown to us; new impressions of regional bird life), several observations in western North and South Dakota are worthy of record. In general, these observations provide either additional records for species at the extremities of their ranges or information on nesting and abundance.

For the racial identification of certain specimens collected we are grateful to Dr. Pierce Brodtkorb of the University of Michigan Museum of Zoology. Dr. Otto McCreary of the University of Wyoming has kindly given us suggestions in the preparation of this paper.

Cliff Swallow (*Petrochelidon albifrons*).—In southwestern North Dakota, highway 85 crosses over large streams on recently constructed culverts. They are made of cement with vertical sides meeting flat roofs at right angles. Near Belfield (Stark Co.) on June 5 we noticed a Cliff Swallow sitting on a guard rail above one such

culvert. When the culvert was investigated, Cliff Swallows roared forth in a veritable frenzy. Although the roof of the culvert was only four feet from the surface of the stream, the angles between the roof and sides were filled to capacity with single rows of nests—approximately one hundred in all. The nests were fully constructed and incubation was under way. Cliff Swallows were later noticed in the vicinity of four other culverts between Belfield and a point forty miles north.

Magpie (*Pica pica*).—On June 3, a nest was found fifteen feet up in a pine beside the highway five miles north of Pactola in the Black Hills of South Dakota. It contained five large young with opened sheaths on all feather tracts.

Eastern Bluebird (*Sialia s. sialis*).—One male was seen near Berg (McKenzie Co.), North Dakota, on June 6. This was our only record in the western Dakotas. Published statements relative to the summer occurrence of the Eastern Bluebird in specified areas of the western Dakotas are contradictory. Visser (Auk, 26: 153, 1909; Auk, 28: 16, 1911), and Reagan (Auk, 25: 467, 1908) indicate its commonness; Larson (Wilson Bull., 40: 110, 1928) calls it uncommon; Cary (Auk, 18: 231-238, 1901) does not list it. Gabrielson and Jewett (Auk, 41: 303, 1924) and Wood (Univ. of Michigan Mus. Zool. Misc. Publ., no. 10: 81, 1923) give scattered records.

Sprague's Pipit (*Anthus spraguei*).—Noted but once when the flight song of this species was heard above an extensive meadow in a ravine near Belden (Mountrail Co.), North Dakota, on June 7.

Western Warbling Vireo (*Vireo gilvus swainsoni*).—Common and in full song in the Black Hills at varying elevations wherever aspens were prevalent. One male in breeding condition was taken on June 3 near the Rushmore Memorial (Pennington Co.) at an elevation of 5,600 feet.

Black and White Warbler (*Mniotilta varia*).—One male was found on June 6 in a thickly wooded gully near the Little Missouri River about three miles north of Mary (McKenzie Co.), North Dakota. When Pettingill drew near, the bird protested by chipping and circling him from tree to tree. The late spring date, the immediate environment, and the behavior suggested the possibility of the bird occupying breeding territory. Larson (Wilson Bull., 40: 108, 1928) has stated that "a few may nest" in eastern McKenzie County. In adjoining counties, early summer dates given by Wood (Univ. Michigan Mus. Zool. Misc. Publ., no. 10: 72, 1923) further indicate that the species may breed in western North Dakota. We are aware, however, of no actual breeding dates from this extreme section of its range.

Oven-bird (*Seiurus aurocapillus*).—Three individuals were heard singing on June 3 near the Rushmore Memorial in the Black Hills at an elevation of 5,600 feet. Although the area was primarily pine-covered, the Oven-birds were found in ravines forested with aspen and birch. Several lists covering the Black Hills (Cary, Auk, 18: 231-238, 1901; Visser, Auk, 26: 144-153, 1909; *et al*) do not mention the species but there are nearby records. In northeastern Wyoming Visser (*cf.* Grave and Walker, Birds of Wyoming: 72, 1913) found it at Hulett and Sundance in June, 1911, and McCreary (Wyoming Bird Life: 94, 1937) found it near Newcastle in June, 1929. Tullsen (Condor, 13: 102, 1911) heard the Oven-bird in spring and summer on the Pine Ridge Reservation (Shannon Co.), South Dakota, and on two occasions discovered it nesting. North of the Black Hills in North and South Dakota there is evidence of its breeding in isolated localities (see Gabrielson and Jewett, Auk, 41: 303, 1924; Visser, Auk, 28: 15, 1911; Larson, Wilson

Bull., 40: 108, 1928). In a wooded ravine near Berg (McKenzie Co.), North Dakota, we noted one singing bird on June 6.

Long-tailed Chat (*Icteria virens longicauda*).—Observed repeatedly in wooded areas of McKenzie, Billings, and Stark counties, North Dakota. One male in breeding condition was collected near Medora (Billings Co.) on June 6.

Orchard Oriole (*Icterus spurius*).—During a two-hour visit to the northern bank of the White River near Stamford (Jackson Co.), South Dakota, on June 3, we counted six males and two females and heard several other individuals singing. All were noted in a sparse growth of cottonwood with low, thickly-growing shrubs. This apparent commonness of the Orchard Oriole along the White River is corroborated by Sweet (cf. Visher, Auk, 26: 149, 1909), his observations being based presumably on a section of the White River between Interior and Kadoka.

Baltimore Oriole (*Icterus galbula*).—Our westernmost record is of a male seen among the shade trees in Watford City (central McKenzie Co.), North Dakota, on June 7.

Bullock's Oriole (*Icterus bullocki*).—Our easternmost record is a male seen along the White River near Stamford, South Dakota, on June 3.

Blue Grosbeak (*Guiraca caerulea*).—Three males were observed along the White River near Stamford, South Dakota, on June 3. They were extremely shy, always keeping well ahead of us as we followed them over the steep, bushy river embankment. The A. O. U. Check-List (1931) does not include South Dakota within the range of the Blue Grosbeak, although there are records for the state. Over and Thoms (South Dakota Geol. and Nat. Hist. Surv., Bull. 9: 118, 1921) state that it is known to nest along the Missouri River as far north as Pierre. Visher (Auk, 26: 151, 1909) took specimens in western South Dakota (locality not given) in August, 1899, and September 2, 1900, and reported (Auk, 30: 280, 1913) an immature specimen collected at Carter (Tripp Co.) on August 16, 1911. Tullsen (Condor, 13: 100, 1911) noticed three males tarrying for several days at the Pine Ridge Indian Reservation (Shannon Co.) late in May, 1905. Youngworth (Wilson Bull., 44: 43, 1932) found it "not uncommon in suitable habitats" in Yankton County. The records cited above refer to the western race (*G. c. interfusa*).

Lazuli Bunting (*Passerina amoena*).—Our easternmost record is a pair seen among low shrubs beside the Riviere des Lacs at Kenmare (Ward Co.), North Dakota, on June 9.

Northern Pine Siskin (*Spinus pinus pinus*).—Numerous flocks were observed in the coniferous woods of the Black Hills on June 3 and 4. The testes of a males taken from a flock near Sheridan on June 4 showed no signs of breeding. On this same day one large flock was noticed among the deciduous trees shading the main street of Spearfish.

Arctic Towhee (*Pipilo maculatus arcticus*).—One pair with gonads greatly enlarged was taken beside the White River, near Stamford, South Dakota, on June 3; several individuals were observed at Kenmare, North Dakota, on June 9. To the west of the above two points, Arctic Towhees were frequently seen in brushy localities. While working through a wooded ravine near Berg, North Dakota, on June 6, we flushed three females from their nests within a period of five minutes. The nests contained, respectively, three newly hatched young, five eggs, and four eggs.

Lark Bunting (*Calamospiza melanocorys*).—In our drive westward through South Dakota from Brookings to the edge of the Badlands on June 2 and 3 the abundance of this conspicuous bird was impressive. Sample counts per mile were made as

we moved along. Only the birds on or within the fences paralleling the road were included. Our estimate was about 15 birds per mile, or roughly 4,125 from Brookings to the Badlands.

Grasshopper Sparrow (*Ammodramus savannarum*).—On one small section of prairie five miles west of Wolsey (Beadle Co.), South Dakota, Grasshopper Sparrows were in abundance on June 3. One breeding male specimen taken is probably referable to the eastern race (*A. s. pratensis*). The breeding range of the eastern form is said to be "east of the Great Plains from southern Wisconsin . . . south to southern Louisiana . . ." (*A. O. U. Check-List*, 4th ed.: 336, 1931). More specimens are obviously needed.

Brewer's Sparrow (*Spizella breweri breweri*).—In South Dakota on June 5 we collected one male and saw another individual near Indian Creek, north of Belle Fourche (Butte Co.). On the same day still another individual was observed near Redig (Harding Co.). The gonads of the bird collected were in breeding condition. All three birds were singing in grassy ravines with no bushes in evidence. In eastern Montana, where the Brewer's Sparrow is a "common summer resident," it breeds in sage brush (Saunders, *Pacific Coast Avifauna*, No. 14, 1921). The *A. O. U. Check-List* (4th ed.: 349, 1931) does not include either of the Dakotas within the eastern limits of the breeding range of the Brewer's Sparrow. Brehens (cf. Visher, *Auk*, 26: 151, 1909) collected one specimen, supposedly within twenty miles of Rapid City, South Dakota, in July, 1899. Reid (*Wilson Bull.*, 40: 201, 1928) collected a singing bird in the North Dakota badlands 18 miles south of Marmarth on May 28, 1928, and on the following day "saw and heard several of these birds a few miles west of Marmarth."—OLIN SEWALL PETTINGILL, JR., *Carleton College, Northfield, Minnesota*, and EDWARD FOX DANA, *Portland, Maine*.

'Courtship Feeding' in the Black-capped Chickadee.—In his recent paper on 'Courtship Feeding in Birds,' David Lack (*Auk*, 57: 169-178, 1940) states that he knew of no fully established case where the feeding was restricted to the period of incubation and consequently it could not be classed as courtship feeding, although it was suspected that this might be the case among certain titmice, crows, and finches. In connection with a special study of the Black-capped Chickadee (*Penthestes atricapillus*) (see *Auk*, 58: 314-333, 518-535, 1941; op. cit., 59: 499-531, 1942), on the Edmund Niles Huyck Preserve, Rensselaerville, N. Y., the writer had an opportunity to follow closely the behavior of this species throughout the year. Observations during the spring indicated that the feeding of the female by the male is not a part of the courtship in chickadees but appears later, particularly during incubation. Neither begging by the female nor feeding of the female by the male was observed before or during the period when pairs first separated out of the winter flocks, which occurred in 1940 between April 10 and 25. During this 15-day period ten pairs were observed, some of them repeatedly and for two or three hours at a time, and only one very weak begging-feeding act was observed. Pairs at this time were clearly mated since they remained closely associated throughout the day and were antagonistic to other chickadees.

The first distinct begging-feeding behavior was noted on May 9 in a pair which had nearly completed excavating a cavity; the male fed the female five times during a two-hour observation period. Between May 10 and 20 the behavior was observed in all pairs which were under observation; all but one of the females at this time were either laying eggs or incubating. During incubation the begging-feeding reached a peak, occurring in all pairs. The female not only begged con-

stantly during the inattentive period off the nest, but the male regularly fed her while she was on the nest. When the young hatched the male almost immediately stopped feeding the female when she was off the nest but continued to feed her during her brooding periods. In several cases the female continued to beg to some extent while off the nest, but the male usually ignored her and fed the young instead. After brooding stopped, all traces of the feeding-begging behavior between the adults disappeared.

To summarize, the feeding of the female by the male and the begging by the female seems to have little if anything to do with the formation of the pair in the Black-capped Chickadee. The behavior apparently may start gradually during nest construction or egg laying (which is at least one to three weeks after definite pairing), then reaches a peak during incubation, and gradually stops after hatching when the male transfers his feeding activity to the young.—EUGENE P. ODUM, *University of Georgia, Athens, Georgia*.

Snow Buntings burrowing into snowdrifts.—During the severe sub-zero weather experienced in New England on February 15–16, 1943, a flock of 150–200 Snow Buntings (*Plectrophenax n. nivalis*), wintering at the Graves Brothers' Farm, Williamsburg, Massachusetts, sought shelter from the 35°-below-zero temperatures and the bitter northwest winds by digging themselves into soft snow under the steep southeast (or leeward) edges of several shallow drifts in an open field. On February 19, when my father, Aaron C. Bagg, and I visited this farm, we saw countless oval depressions still remaining in the snow just under these small 'snow-cliffs,' and Dwight Graves told us that on February 15, when the temperature did not rise above –20° F. all day, the Snow Buntings remained huddled in these holes, leaving only occasionally to feed on a nearby chaff pile. The snow around these depressions was littered with droppings.

According to Forbush ('Birds of Massachusetts and Other New England States,' 3: 35, 1929), "when the snow is soft, these birds are said to dive into it . . . and there pass the night. When the snow is frozen hard, the flocks sleep in the open, protected from the north wind only by some slight rise in the ground, by sand dunes, or by a stone wall." (See also Thomas S. Roberts, 'The Birds of Minnesota,' 2: 454, 1932.) In the case described above, however, the Snow Buntings sheltered in the snow during daylight hours as well as at night. Nearby were stone walls, an extensive, thick, pine grove, farm buildings, and apple trees (in which we saw over 100 of these birds perching on February 19, a milder day). Is it not fair testimony of both the weather's severity and the birds' basic instinct that in Massachusetts the Snow Buntings did as they must do in the extreme Arctic regions where there is no shelter but that afforded by snow and ice? Is it not the same procedure which must be followed by such Snow Buntings as those seen by the Nansen Polar Expedition between 84° and 85° North Latitude (about 90° East Longitude in May, 1895, and 15° East Longitude a year later)—both points being considerably north of any known land?—AARON MOORE BAGG, *Holyoke, Massachusetts*.

Swimming ability of young Robin.—The interesting observation of George A. Petrides, concerning the swimming ability of a young Catbird (Auk, 59: 584, 1942) leads me to report a somewhat similar happening experienced by my friend, Miss Edith McL. Hale, who wrote to me as follows, under date of June 3, 1942:

"I was seated beside Willow Pond at Mt. Auburn [Cambridge, Mass.], when a little bird fluttered low over the pond at some distance from me and dropped to

the water. It turned and began to swim toward the land. After progressing a yard or more it stopped to rest. This was repeated again and again until I was sure that it was a land bird making frantic efforts to reach the shore. A group of men was raking the mown grass with long wooden rakes, and I asked the nearest man to please put his rake as far out as possible so that the bird could reach it. The baby Robin, for so it proved to be, made another frantic effort for a yard or more, flapped its little wings as fast as possible, reached the rake and was drawn safely to shore where it sat panting on its life preserver . . . The wings had white spots and natal down was in evidence."—MAURICE BROWN, Hawk Mountain Sanctuary, Route 1, Orwigsburg, Pennsylvania.

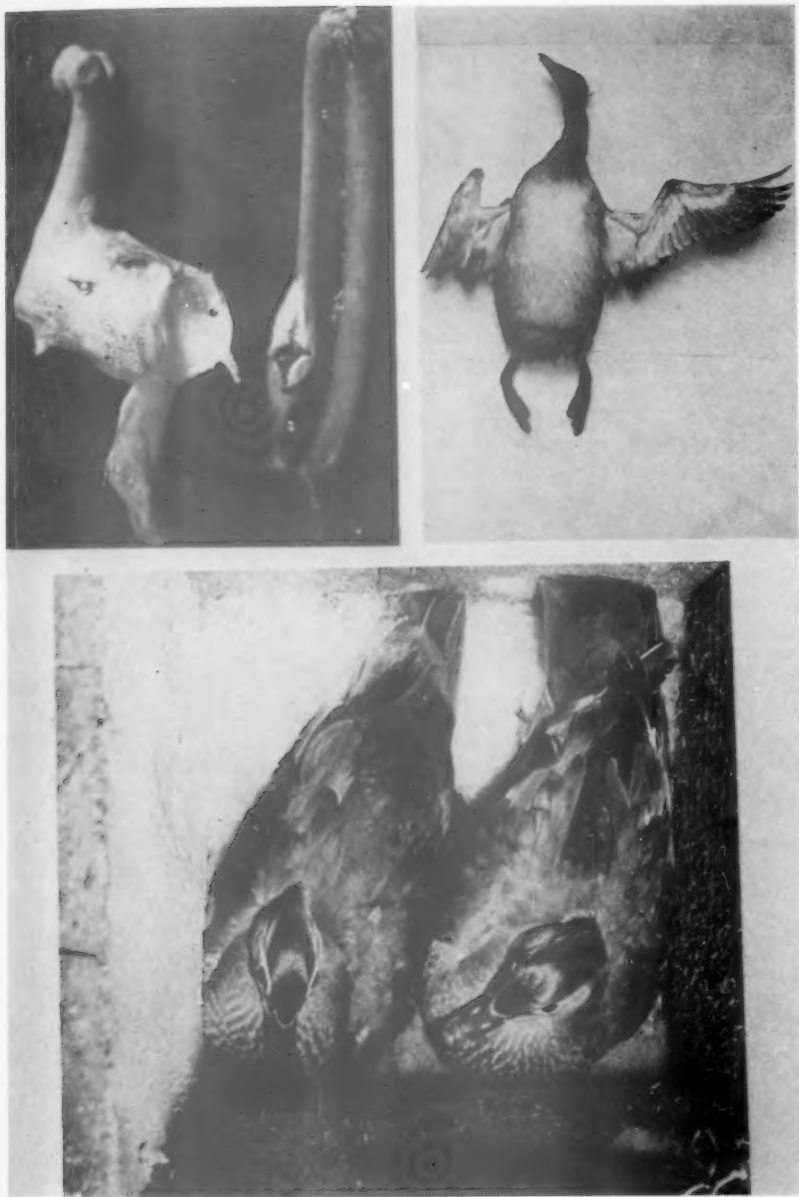
Two Wood Ducks incubating in the same nesting box (Plate 12, lower figure).—It is rare indeed to find two non-colonial birds of the same species incubating their eggs side by side in one nest, and it is all the more unusual when the species happens to be a cavity-nester. Two female Wood Ducks (*Aix sponsa*) were discovered engaged in this nesting procedure in 1942.

During the inspection of approximately 700 Wood Duck nest boxes (erected by the Illinois Natural History Survey as part of an intensive research program on the life history and management of the Wood Duck), the writer discovered the 'twin' incubators in a box on the premises of Dr. Frank Green, Chillicothe, Illinois, May 19, 1942. Dr. Green, who was away on vacation at that time, reported that on April 16, the box held two young fox squirrels. By April 26, the fox squirrels had departed and four Wood Duck eggs were in the box. On May 4, eight days later, the box contained nineteen eggs, which represented an average laying rate of almost two a day, indicating that two females were laying in the same nest. Community nests are of frequent occurrence with the Wood Duck; in fact seven of the eight Wood Duck nests located on Dr. Green's premises in 1942 were community or 'dump' nests.

Dr. Green removed five of the nineteen eggs, placing them in other boxes. On May 19, two hens were incubating thirty-four eggs; later two eggs disappeared. When I inspected the box on May 29, at 6 P. M., I found one female away, evidently feeding, while the other one continued to incubate one-half of the nest. This discovery led to the conjecture that perhaps the hens recognized a particular part of the nest as their own. Consequently, Dr. Green marked one hen. For several days thereafter the birds maintained their respective incubating positions. However, after that they frequently shifted positions, displaying no attachment for any certain part of the nest.

According to Dr. Green, the eggs were hatching on June 8. By June 10, one hen had departed with twenty-six ducklings, while the other remained in the box with three weak ducklings and three unhatched eggs. On the following day, the remaining hen left with two ducklings, leaving one weak duckling and three unhatched eggs.

It is remarkable that the maternal instinct of these two female Wood Ducks overcame the intolerance that individuals of most species generally exhibit toward others of the same species. Despite the facts that Wood Ducks often lay in community nests, that several pairs may associate together early in the breeding season and that several pairs may, through sociability, be induced to nest in the same vicinity, Wood Ducks have been observed to be intolerant of one another. On more than one occasion a male—perched on a limb near a nest box inhabited by his laying mate—has been seen to lunge and drive a newly arrived pair from the same limb.



(Upper left) ABBOTT: BONE REPAIR IN DUCKS. (Upper right) ERNST: DEFORMATION IN THE WING OF A PIED-BILLED GREBE. (Lower) BELLROSE: TWO WOOD DUCKS INCUBATING IN THE SAME NESTING BOX.

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Dr. Hurst Shoemaker of the University of Illinois informs me that frequently two female canaries may lay and incubate their eggs in the same nest. Under domestic conditions, morals of wild birds often break down. Wild birds under captivity may display this trait more commonly than birds in the wild.—FRANK BELLROSE, JR., *Illinois Natural History Survey, Urbana, Illinois.*

Bone repair in ducks (Plate 12, upper left figure).—The paper by Otto W. Tie-meier in the issue of 'The Auk' for July, 1941, reminded me that several years ago a young man presented me with the mended wing bones of two ducks which were shot, so he told me, in flight. I am not certain as to the species, but believe both were Mallards. In one specimen the radius had been fractured, and had mended without any distortion save a prominent callus. In the other specimen the humerus had been broken in the middle, the broken ends separated, and later fused through a flat bridge of bone. It is remarkable that a bird so handicapped should be able to fly.—CYRIL E. ABBOTT, *Searcy, Arkansas.*

Deformation in the wing of a Pied-billed Grebe (Plate 12, upper right figure).—A Pied-billed Grebe (*Podilymbus podiceps podiceps*) of great interest was received at the Zoology Laboratory of the New York State College of Forestry on October 15, 1942. The bird was one of ten brought to the laboratory by Game Protector Charles Hunter; the birds had been shot by duck hunters at Dalton Beach, Oneida Lake. This lake is frequented each fall by a great number of hunters from the nearby city of Syracuse, and the supposition is that a great number of grebes are mistaken for ducks and killed.

With a view to preparing the skins for the Roosevelt Wildlife Station museum, I closely examined each bird. The last bird to be examined was found to have a deformed and stunted wing. It was the belief of the staff that the bird had never flown; the wing and feather area were far too small to support the bird's body weight. Further examination showed the bird to be an immature. Having no power of flight, the grebe had been forced to rely on its swimming and diving prowess to escape predators and secure food. Oneida Lake is lined with summer cottages, and the summer human population is great. This fact plus the number of the bird's natural enemies (large fish, muskrats, snakes, and certain birds of prey) would lead me to believe that 'the survival of the fittest' should be modified to 'the survival of the luckiest.'

Except for the wing deformity, the bird was in excellent condition. Body weight was as heavy as, or heavier than, some of the others examined, plumage was in fine shape; internal organs were sound. There was a noticeable under-developed condition of the pectoral-muscle tissue as would be expected in a non-flying bird. Measurements showed the normal right wing extended to be 20.2 centimeters, while the stunted left measured only 8.5 centimeters. These measurements were made from the point of attachment to the body to the first primary feather, with the wing extended as shown in the photograph. Measurement from tip of bill to tail was 31.3 centimeters.

It is supposed that the bird was hatched with the deformed wing, for the bone structure at the carpal joint showed complete fusion; it was this malformation which made normal extension impossible. The bird must have led a solitary life—a life fraught with danger and hardship. It is probably just as well that this bird was quickly killed by a hunter's gun, for winter ice covers the largest part of Oneida Lake and the bird's problems would have been increased two-fold.

Photo by Dr. Justus F. Mueller.—STANTON GRANT ERNST, *New York State College of Forestry, Syracuse, New York.*

Goshawk nesting in Hampshire County, Massachusetts, in 1941 and 1942.—Although Massachusetts is outside of its common nesting range, the Eastern Goshawk (*Astur a. atricapillus*) has, since 1922, nested with some regularity in northwestern Worcester County, and in 1931 a pair raised three young in northwestern Hampden County (see Bagg and Eliot, *Birds of the Connecticut Valley*: 152-154, 1937). From intervening Hampshire County, however, no breeding record was known prior to 1941. On April 20 of that year a pair was found nest-building by John M. Black, who lives in the northwestern part of Williamsburg and likes to spend his Sundays rambling in the forest that covers the hills to the westward. The nest was remote from any house or road, near the eastern edge of the township of Chesterfield, and some 1500 feet above sea-level. It was about 50 feet up in a white pine, and seemed half-built on April 20 but completed on April 27. Both birds were solicitous on May 4, but thereafter only one adult, seemingly the female, was noted. I climbed to the nest on May 9, found three eggs, and (to establish the record) took one of them which proved to be heavily incubated. The feet of the embryo were well formed, with toes a quarter-inch long. Diligence and patience at last emptied the shell, which is preserved in the Museum of Natural History at Springfield. It measures $2\frac{3}{8}$ by $1\frac{11}{16}$ inches.

On May 30, the two young, still downy and timid, were photographed by J. B. Mills of South Hadley. On June 19, one of them had disappeared, and a few days later the other, now nearly fledged, was carried off by a Northampton school-boy who hoped to train it. He kept it (but failed to tame it) until the end of July when it escaped, trailing its jesses; and though it was banded (36-714706), I have heard nothing more about it.

On April 19, 1942, Mr. Black found Goshawks again! Apparently the surviving adult of 1941 had brought a new mate to the mountainside, though not to the ill-fated tree. The nest, higher than before, was in another white pine about 200 yards southeast of the former one, and almost unclimbable. To aid successful breeding, Mr. Black told nobody of this nest until the young birds left it, shortly before June 28. There seemed to be only two. On July 7, I saw one of them by itself, and Mr. Black saw the other with one parent not far from the nest tree. From the base of this tree I gathered pellets and other refuse containing remains of at least two gray squirrels, a Blue Jay, and a banded pigeon. On August 2, one young Goshawk was still near the nest.

In both years, although spring was early here, egg-laying was curiously later than one would expect, especially at such a low latitude. At Petersham, Massachusetts, well-incubated eggs were collected on April 28, 1923, and April 18, 1924, and in North Chester, four eggs had already been laid on April 20, 1931. Near Mt. Monadnock, New Hampshire, three eggs were collected on April 24, 1941 (Auk, 58: 572, 1941), probably before our Massachusetts hawk had even begun to lay. Mr. Abbott, in the record just cited, makes no mention of the Mt. Monadnock Goshawk-nesting of 1933, recorded in 'The Auk,' 51: 80, 1934.—SAMUEL A. ELIOT, JR., 31 *Dryads Green, Northampton, Massachusetts.*

Scissor-tailed Flycatcher in St. Johns County, Florida.—Records of the Scissor-tailed Flycatcher (*Muscivora forficata*) in northern Florida are still not so common but that its occurrence in new areas should be recorded, especially when there are

so few published records from the coast of northeastern Florida. A single individual was observed perched on a telephone wire along highway No. 140 at St. Augustine Beach, St. Johns County, Florida, November 22, 1941. The bird was studied closely with 8 x 30 binoculars at a distance of thirty-five yards and the salmon-pink sides were plainly visible. The bird was flushed three times and twice it alighted on the telephone wire, but the last time it flew into a clump of scrub oak. During these short flights, the forked tail was conspicuously displayed. The writer had never before observed the species in life but the markings and flight characteristics were so evident that he has no doubt of the identification.—RAYMOND J. FLEETWOOD, *United States Fish and Wildlife Service, Round Oak, Georgia.*

Scissor-tailed Flycatcher in Pennsylvania.—On November 22, 1942, Martin Stapleton of Rothsville, two miles east of Lititz, Lancaster County, Pennsylvania, called me on the phone to say that he had seen a Scissor-tailed Flycatcher near his home. I arrived at his place in about fifteen minutes and found the bird perched on an apple tree. It was a male in full plumage with the forked tail at least twelve inches long. I photographed it with a telephoto lens and secured a fairly good picture of it. This is a new record for Lancaster County and also, so far as I know, for the State of Pennsylvania. The nearest record I can find is of one shot at Trenton, New Jersey, by Dr. Abbott in 1872.—BARTON L. SHARP, 201 North Broad Street, Lititz, Pennsylvania.

Oregon Junco in Ohio.—A male *Junco oreganus* appeared at a window feeding station of a small sanctuary area bordering Oxford, Ohio, on January 7, 1943. This bird has remained in the vicinity for three months and has been seen by no less than a dozen persons, including the following professional biologists: M. W. Boesel, P. S. Crowell, Edna Drill, Mrs. M. W. Boesel, and the undersigned zoologists. The black head and throat, the convex postero-ventral border of the black area, the brown back, and the washed pink coloration of the sides clearly distinguish this bird from our common Slate-colored Junco. On January 14 this male was taken in a funnel trap and the following measurements were made:

| | | | |
|----------------------|--------|--------------------|---------|
| Lower mandible | 7 mm. | Tail | 65 mm. |
| Upper mandible | 9 mm. | Total length | 147 mm. |
| Wing | 80 mm. | | |

The male was banded on the right leg before he was released. On January 9, a female *J. oreganus* appeared in the same territory and has since associated with the male. The pair shows no tendency to flock with *J. hyemalis* in our area. On March 7 both birds were taken in a funnel trap and good Kodachrome photographs were obtained. The female was banded on the left leg at this time. The 1-a bands are as follows: male, right leg, no. 39-131102; female, left leg, no. 39-131103.—R. A. HEFNER AND N. T. MATTOX, *Department of Zoology, Miami University, Oxford, Ohio.*

White-winged Dove in Ontario.—On June 17, 1942, an Indian shot a White-winged Dove (*Melopelia asiatica*) at Fort Albany, Ontario, N. Lat. 52.1°, W. Long. 81.6°, on the west coast of James Bay. The bird was brought to the writers, who were conducting field work in the area, within a few minutes of the time it was shot. It was an adult male and possessed enlarged testes. There was nothing about its plumage to suggest that it had escaped from captivity. This constitutes the first

known occurrence of this species in Ontario. There is one previous Canadian record for Vancouver Island, British Columbia (Kermode, Rep. Prov. Mus. Nat. Hist., 1921: 11-12).

The coloring of the unfeathered parts was recorded as follows: bill, black; iris, apricot orange; naked skin about eye, light cadet blue; tarsus and toes, eugenia red; under surface of toes, light drab; claws, vinaceous drab (Ridgway, 'Color Standards & Color Nomenclature,' 1912).

Comparison shows the specimen to be typical of the form *M. a. mearnsi* on the basis of color. Its measurements, which follow, are close to the averages given by Ridgway ('Birds N. and Mid. Amer.,' U. S. Nat. Mus., Bull. 50, pt. 7: 376-385, 1916) for *mearnsi*: Length, 285 mm.; extent, 460; wing, 162; tail, 108; exposed culmen, 21; middle toe, 27; weight, 131 grams. The specimen is now No. 67776 in the R. O. M. Z. collection.—T. M. SHORTT AND C. E. HOPE, *Division of Birds, Royal Ontario Museum of Zoology, Toronto, Ontario.*

Another Blue Goose in Maine.—In recent years, and especially since 1935, there has been a marked increase in the number of Blue Goose (*Chen caerulescens*) records in the states along the Atlantic coast (Clarence Cottam, Auk, 52: 432, 1935). However, Maine seems to have been skipped, even in years when records from Massachusetts and states southward were common. Therefore the appearance of another Blue Goose in Maine is worthy of a report.

Robert Weston of Salmon Pool Farm, Brewer, Maine, has presented Bowdoin College with a skin of a Blue Goose which was caught in a muskrat trap near Brewer on April 16, 1942. The bird had been seen, on several days previous to its capture, in company with a Snow Goose. Blue Geese associate with Snow Geese during their entire existence, both in summer and winter, and on their migration, and is even known to interbreed; hence its intimate association with a Snow Goose is not at all surprising.

This bird, as far as I have been able to ascertain, furnishes the first spring record and the third authentic record of any kind for the State of Maine. The first was taken at Little Spoon Island, Jerico Bay, Hancock County, on November 15, 1913 (Charles E. Clarke, Auk, 33: 198, 1916), and the second at Lubec on September 27, 1924 (Arthur H. Norton, Auk, 42: 265, 1925). The Brewer specimen is in juvenal plumage but has patches of white on its head and neck indicating progress of transition to the adult plumage.—ALFRED O. GROSS, *Bowdoin College, Brunswick, Maine.*

Upland Plover in Adams County, Pennsylvania.—I was interested in Mr. Herbert H. Beck's article in 'The Auk' for January, 1942, reporting an increase in the Upland Plover population in Lancaster County, Pennsylvania. It seems that it is also increasing in Adams County, since Mr. R. C. Harlow found several pairs breeding there in 1934, and on May 30, 1935, I found eighteen individuals in a single meadow west of Gettysburg. The birds nested early that season because chicks ranging from four to eight days old were found.

Their increase in this area may possibly be attributed to their being less conspicuous than other field birds. Five persons queried in the immediate area had never heard of such a bird and the farmer on whose place I found the plovers breeding thought they were Meadowlarks.—BROOKE MEANLEY, *Patuxent Refuge, Bowie, Md.*

Unusual records for eastern Maryland.—Wilson's Petrel (*Oceanites oceanicus*)—In one century, just five specimens of this petrel have been taken on the inland tidal waters of the state, the first having been recorded in 1842. Four of these records have been previously published (Auk 42: 262, 1925). The fifth is a specimen taken at Kenwood Beach, Calvert Co., July 24, 1936, by B. Kaiser, which we discovered while cataloging the collection of R. Bruce Overington of Laurel, Maryland (R. B. O. No. 797).

Orange-crowned Warbler (*Vermivora celata celata*)—This warbler is accidental in eastern Maryland, two previous specimens being known. A third specimen was taken by Bond at Elkridge, Howard Co., on October 3, 1942 (N. H. S. Md. No. 488).

Eastern Evening Grosbeak (*Hesperiphona vespertina vespertina*)—Previous to 1942, but one invasion of this species has been recorded for the state; in the spring of 1922 small flocks were noted at several points around Washington. On January 17, 1942, two adult males were taken near Towson, Baltimore Co., by Kolb (N. H. S. Md. Nos. 428 and 429). No others were seen. Examination of the stomachs showed that the birds had been feeding on the seeds of the osage orange (*Maclura*). Though perhaps themselves capable of tearing apart the very heavy and compact syncarps with their massive beaks, it is more likely that in the present case the seeds were obtained from those already plentifully demolished by red squirrels.—HAVEN KOLB AND GORMAN BOND, *The Natural History Society of Maryland, Baltimore, Maryland*.

Audubon's Warbler in Ohio.—While the writer heartily endorses a policy of extreme caution in publishing sight records of casual or accidental bird occurrences, yet he feels that there are times when favorable field conditions combine to reveal diagnostic characters so surely as to eliminate all probability of error. It is felt that such observations, carefully made, have a very real value; the following, as one of them, is here presented for what it is worth.

While watching a varied company of migrant warblers at Richmond, Lake Co., Ohio, in the early afternoon of October 5, 1941, Miss Ruth Newcomer, of Novelty, Ohio, drew my attention to "a warbler with a yellow throat" which she had glimpsed just as it disappeared into a sparse thicket of young oaks. Almost at once the bird reappeared, this time on my side of the thicket, some twenty feet away, and before I could raise my binoculars it was obvious that here was an Audubon's Warbler (*Dendroica auduboni*)! This was, for an autumn bird, a strongly marked individual, apparently an adult male, the throat patch being sharply defined and of a uniform, rather bright yellow that differs unmistakably from the buffy wash that not infrequently is shown (and in some lights is highly intensified) on the throats of some young autumn Myrtle Warblers. Numerous opportunities presented themselves for careful comparisons with the ubiquitous Myrtle Warblers and although we could not determine a greater amount of white in the tail of our bird, yet we both felt sure of broader light margins on the greater wing-coverts as compared with these feathers on the Myrtles nearby. Furthermore, on at least two occasions when the Audubon Warbler had disappeared after a short flight, it was again located by ear, the quality of its 'chip' differing slightly but definitely from that of the Myrtles. Never during the forty-five minutes through which it was kept under observation did this bird wander more than fifty feet from the thicket wherein it was first noted. Indeed this thicket appeared to be the center of the bird's activities, and it returned again and again

after short excursions into foliage near at hand. Finally we left the area, not because further observation was impossible but because we felt that identification was complete. Late in the afternoon we returned and easily found the bird again—in the same thicket.

Observance of the law prohibiting the use of firearms on Sundays precluded collecting the specimen, and a full-day search for it on the following day failed completely. There is but one other recorded instance of the occurrence of the Audubon's Warbler in Ohio—a male, carefully observed by W. H. Watterson at Cleveland on April 30, 1931, and again on May 3 of the same year [Auk, 48 (3): 435, 1931].—W. EARL GODFREY, *Cleveland Museum of Natural History, Cleveland, Ohio.*

Eared Grebe in Ohio.—On April 21, 1941, an Eared Grebe (*Colymbus nigricollis californicus*) was observed and identified by Mr. B. Patterson Bole, Jr., at Corning Lake, Holden Arboretum, Lake Co., Ohio. On April 22, the following day, the writer, on being told by Mr. Bole of this observation, at once drove to Corning Lake and there found the bird without difficulty. Two migrant Horned Grebes, together with several Pied-billed Grebes, were feeding near shore on one side of the small lake; the Eared Grebe, alone, was close to the shore remote from that favored by the other birds. It remained solitary throughout the hour during which it was watched, confining its movements within a comparatively small area of rather shallow water. It was extremely active, diving very frequently, but not once did it remain under water for more than thirty seconds.

This bird, a first-year male in prenuptial molt, was collected and is No. 40528 of the bird collection of the Cleveland Museum of Natural History. It constitutes the first record of the occurrence of the Eared Grebe in Ohio.—W. EARL GODFREY, *Cleveland Museum of Natural History, Cleveland, Ohio.*

Black-throated Gray Warbler at Miami, Florida.—December 26, 1942, seen by Mr. Albert L. Dietrich and Mr. Louis A. Stimson; January 3, 1943, seen by Mr. Stimson; January 4 and 5, seen by Mr. Stimson and Dr. Frank M. Chapman, Mr. and Mrs. Edward Clarence Dean, and Mrs. Frank G. Cox; January 6, seen by Mrs. Cox and Mr. Augustus S. Houghton; January 10, seen by Mr. Stimson and Mr. Bob Woodmansee.

The location was in Matheson Hammock County Park, a wildlife sanctuary, situated about nine miles from the center of Miami. On December 26, after Mr. Dietrich called my attention to this bird, we both had several close views with 7 x 35 binoculars. The gray back, black cap, broad white stripes above the eye, broad black stripes through the eye, white throat with more or less black streaking on the sides and flanks, and white wing-bars were noted. The day was cloudy and we saw no yellow loreal spot. From the plate in Dr. Chapman's 'Warblers of North America' we identified the bird as a female Black-throated Gray Warbler. Needless to say we were amazed at its occurrence in Florida.

January 3 and 4 were bright, sunshiny days and in certain lights the bird's yellow loreal spot was visible. It could not be seen at all times, but seemed to show best when the bird was on the shady side of a branch with little direct sunlight on the bird itself. The bird was feeding with a large group of Western Palm Warblers and Blue-gray Gnatcatchers in a small clump of acacia trees which were mostly denuded of leaves. At no time did I hear it give any call. It had distinctly creeper-like habits, moving up the tree trunks or along the branches in a way similar to the Black and White Warbler. Mr. Houghton and I each attempted

to get some motion pictures of the bird. A few feet of my film came back fairly good, a few frames showing the head markings quite plainly; I have not heard as to Mr. Houghton's results.—LOUIS A. STIMSON, *Miami, Florida*.

Status of the White-winged Scoter in Louisiana.—Although the White-winged Scoter (*Melanitta deglandi*) has been recorded in the literature as having been taken in Louisiana at least twice, the bird seems sufficiently rare in this state to merit special mention of recent record. All the records for the species in Louisiana listed by Oberholser ("The Bird Life of Louisiana," Louis. State Dept. Conserv., Bull. 28, 1938) were obtained in the two most southwesterly parishes of the state. According to this source:

"The White-winged Scoter is an accidental winter visitor on the coast of Louisiana. A young male was taken a few miles south of Cameron Farm, which is in Cameron Parish, 14 miles south of Venton, during the latter part of December, 1924, by Elmer Bowman (A. M. Bailey, Auk, 42, no. 3: 442, July, 1925). There is also a male specimen in the museum of Tulane University, killed on the Sabine River in Calcasieu Parish, March 1, 1900."

On April 17, 1932, Mr. Jack Gunn, of Lake Charles, Louisiana, collected a male and a female near Big Lake, Cameron Parish. The female was too badly damaged to be mounted, but the male was mounted and put on display in Mr. Gunn's sporting goods store in Lake Charles.

A female, shot during the hunting season of 1938 at the Lake Arthur Gun Club in Cameron Parish, is now mounted and displayed in their clubhouse. It is unfortunate that the exact date of collection cannot be given. During December, 1940, a male was taken at the same hunting club. Both specimens were inspected and identified by Mr. Earl L. Atwood, Superintendent, Lacassine Migratory Waterfowl Refuge. It may also be reported that Mr. Atwood observed a male at close range on the Lacassine Refuge on December 11, 1939.

On a small pond supporting a luxuriant growth of submerged aquatic plants, near Holly Beach in Cameron Parish, a female specimen was taken by Houston C. Gascon, U. S. Game Management Agent, on December 20, 1941. This skin was prepared by the writer and is now deposited in the Fish and Wildlife Service's collection at Washington, D. C.—JULIAN A. HOWARD, *Fish and Wildlife Service, Sulphur, Louisiana*.

Recent interesting Louisiana records.—On February 13, 1942, I observed a male Vermilion Flycatcher (*Pyrocephalus rubinus mexicanus*) perched on the top wire of a barbed-wire fence along a marshy field one-half mile north of the Lacassine National Wildlife Refuge headquarters, in Cameron Parish, Louisiana, near the town of Lake Arthur. The bird was observed for fifteen minutes through binoculars at a distance of seventy-five feet. Its color, size, and typical feeding habits left no doubt as to its identity. After this date, the bird was observed almost daily until March 16, within one hundred yards of the same spot. Only one individual was seen during this period and it is concluded that only one bird was present in the area. E. A. McIlhenny (Auk, 52: 187, 1935) recorded an example taken December 22, 1934, and Oberholser ("The Bird Life of Louisiana," Louis. State Dept. Conserv., Bull. 28: 401, 1938) lists a record on February 7, 1938, by George H. Lowery, Jr.

According to Oberholser (tom. cit.: 117) the Blue-winged Teal is a permanent resident throughout the greater part of Louisiana. However, the latest spring record listed by him is April 18 except for one record of eggs on May 9. It is very

probable that all of the April records were of migrants. I have observed this species to be common in Cameron Parish in late April since 1940, when I began spring observations in this area. In 1940 and 1941 this species was common on the Lacassine National Wildlife Refuge during the last week in April. On April 22, 1942, I observed approximately 300 Blue-winged Teals, as many as sixty to a flock, in Sabine National Wildlife Refuge; smaller flocks were observed until April 26. There is no question but that these birds were migrants, since no additional birds were seen during daily field observations until May 14 when a male was observed on a small pond near Hackberry. On June 11, 1942, Mr. John Lynch and I flushed a teal in a marsh near Southwest Pass. The female exhibited the broken-wing behavior but no nest or young were found. The flight of the male was not as strong as usual and it was surmised that he was beginning or recovering from the spring molt. While with Mr. Lynch again on June 14, 1942, we flushed a Blue-winged Teal female from a nest containing ten eggs, one of which was broken in her hurried exit. The embryo was fully developed and probably would have hatched within two days. This nest was located in a salt-grass marsh (*Distichlis spicata*) just behind the Gulf Ridge south of Grand Chenier. On July 4, 1940, I observed five Blue-winged Teals flying across Lake Misere and on July 30, 1942, I observed seven flying over Mud Lake. These late summer records and the additional nesting record more definitely establishes the species as a permanent resident. The nest location is interesting because it is the same from which Kennard (Auk, 36: 455-460, 1919) collected the type specimen of what he called the "Southern Blue-winged Teal (*Querquedula discors albinucha*). This has not, however, been generally recognized as distinct.

Audubon's Caracara (*Polyborus cheriway auduboni*) is only a casual visitor to the coast region of southern Louisiana, and there is no actual record of its breeding in the State, according to Oberholser (tom. cit.). However, on June 10, 1942, Mr. John Lynch and I observed a pair of these birds near Gum Cove in Cameron Parish. On making inquiry of local residents concerning the occurrence of these birds, we were advised by Mr. Ves Moore and Mr. Stein, who live in this area, that these 'Mexican eagles' have been observed by them at least for five or six years, but only one or two at a time. We were further advised that a bulky nest had been built at one time by these birds in a dead cypress tree in Black Bayou, nearby. Further evidence that the species is nesting in this area was obtained by Mr. Lynch on May 26, 1942, when he observed two caracaras mating on the prairie at the same place where we observed them on June 10. Several thousand acres of prairie land still exist in the Gum Cove area which, except for more abundant rainfall, is not greatly different from areas in Texas and Mexico where I have observed the species to be numerous. It seems probable that, as a permanent resident, this species will be limited to this prairie area of southwestern Louisiana, since the remainder of the former prairie land is now cultivated. An ecological note of interest is that although Attwater's Prairie Chicken was driven from this same prairie land by grazing livestock and by human habitation, the caracara was more adaptable. A collection record from this area in 1879 indicates that the caracara was at least a casual visitor at that time when Attwater's Prairie Chickens were very numerous in the area. The prairie chicken was last recorded from this area in 1919 although residents report that a few birds remained for some time after that date.

On August 30, 1942, at 4:30 P. M., I observed a Noddy Tern (*Anous stolidus*

stolidus) alight on the porch roof of the manager's dwelling at the Sabine National Wildlife Refuge near Hackberry in Cameron Parish, Louisiana. The bird was observed for about fifteen minutes before it was collected; it allowed me to approach within thirty feet without exhibiting signs of alarm. It is believed the Noddy was driven westward and inland by a storm which was accompanied by a southeast wind reaching gale velocity, on October 29 and on the morning of the 30th, along the Cameron Gulf coast. Examination after collection revealed it to be an adult male. Identification was later verified by Mr. George H. Lowery, Curator, Louisiana State University Museum of Zoology.

Oberholser (tom. cit.: 311) notes that this species has been reported by several authors to occur on the Louisiana Gulf coast but that he was unable to verify the reports. Correspondence with Oberholser and Lowery since the specimen was collected establishes this to be the first definite record for the Noddy Tern in Louisiana. The specimen will be deposited with the Fish and Wildlife Service collection in the U. S. National Museum.—EARL L. ATWOOD, Sulphur, Louisiana.

Violet-green Swallow in southeastern Minnesota.—On the afternoon of October 25, while watching some Mallards on a small pond three miles west of Rochester, Minnesota, I noticed a pair of swallows flying over the pond. On closer inspection it soon became apparent that the birds were not Tree Swallows as I had at first supposed but a species new to me. I observed them in good light for perhaps fifteen minutes from a distance of fifty feet through 6 x 30 Bausch and Lomb binoculars. It seemed certain that the birds were Violet-green Swallows (*Tachycineta thalassina lepidus*). They were the size and shape of Tree Swallows. The back was an unusual shade of bright greenish purple and on each side of the rump there was a patch of white, the two patches nearly meeting in the mid-line. Another conspicuous mark was the facial configuration, the white of the throat apparently partly encircling the eye. The underparts were white and the wings and tail black.

The day was quite cold, with the temperature around 20 degrees F., and with a strong northwest wind blowing. The swallows faced into the wind, most of the time, hovering motionless a foot or two above the edge of the pond. Occasionally they alighted on the shore, apparently attracted by masses of foam whipped to the water's edge by the wind. At noon the following day they were seen again. During the night the pond had frozen solid and the wind had abated. The birds appeared tired and flew only a moment or two at a time. They spent much of the time sitting on the ice, frequently pecking at it. Shyness was so lacking that I was able to approach within a few feet and verify completely the notes previously made. There appeared little possibility the birds could survive, for the weather remained below freezing for several days after they were seen.

Dr. Thomas S. Roberts, of the Minnesota Museum of Natural History, very kindly loaned me skins of the Tree Swallow and Violet-green Swallow for study. There was no reasonable doubt that the birds I had seen belonged to the latter species. Doctor Roberts ("The Birds of Minnesota") accords the Violet-green Swallow a place on the hypothetical list for Minnesota on the basis of a note by Hatch (Bull. Geol. Nat. Hist. Surv. Minn., 1881), but there is no other record of its occurrence in the state. Judging by the dates given by Bent, the bird is a rather early migrant in its normal range, so that its occurrence in this latitude at the end of October makes the foregoing record doubly remarkable.—F. R. KEATING, M.D., Rochester, Minnesota.

RECENT LITERATURE

A Naturalist Afield in Ireland.¹—This volume, which somehow escaped earlier review in 'The Auk,' is one of the most sympathetic studies of nature by recent authors. One is unable to read its pages without finding himself carried into the woods and hills of Ireland with which the author is so familiar. Whether he is describing a boyhood discovery of a wren's nest, a study of the young Cuckoo's efforts to eject a foster-parent's egg (or an apple) from the nest, or the activities of a Short-eared Owl, he is at once the careful observer and the critical recorder. When he recounts a visit to Strangford Lough in summer and again in winter, a journey to Ratlin Island or to Lough Neagh, the scenes and the bird life become alive. Woven through the descriptions and observations on the wild life of the region are bits of folk-lore and legend, of which Ireland is full, and of authentic history. Interspersed also are pertinent discussions of birds and bird behavior in Ireland as well as in other lands that the author has visited. The style is that of the essayist, not the closet naturalist, and the book makes pleasant and stimulating reading. An assortment of excellent photographs, almost all of birds, gives added value to the book which deservedly brought the author the John Burroughs Medal of 1942.—J. T. ZIMMER.

British Birds.²—Mr. Fisher has prepared an interesting survey of British bird life, giving a brief summary of the natural conditions in the British Isles in relation to the native avifauna and the changes that have taken place through the years, with something of the notable figures among British ornithologists. A list of the British birds, grouped as residents, seasonal visitors, rare vagrants, etc., closes the text. Of equal interest are the numerous illustrations which are reproductions of the work of twenty different artists that have appeared in many standard works, such as Albin, Audubon, Bewick, Grönvold, Gould, Lodge, Millais, Thorburn, and Wolf, to mention some of the best-known. The little volume forms one of a series known as 'Britain in Pictures.'—J. T. ZIMMER.

Conservation in Action.³—One of the most potent factors in the struggle to preserve vanishing forms of animal life from virtual or total extinction on the North American continent has been the establishment of wildlife refuges in suitable places throughout the land. Progress has sometimes been slow—species near extinction can not suddenly recover full-fledged vigor and sometimes not at all—but the results are becoming increasingly obvious. The growth of the sanctuary idea was equally slow from the first-recorded state refuge in California in 1870 through the first federal refuge in 1903 to the extensive system of national, state, and private reserves, parks, and monuments that now dot the map. The good work was started none too soon. The abundance of animal life that the early colonists found here closed their eyes to the unalterable laws of diminishing returns, and the vast herds of bison and flocks of Passenger Pigeons and wildfowl sooner or later showed signs of the continued persecution. Fortunately the effort did come, late but not too late for many of the threatened forms, but it has been a persistent struggle against lethargy and opposition and it still requires constant watchfulness to prevent a loss of all that has been gained.

¹ Armstrong, Edward A. 'Birds of the Grey Wind.' 8vo, xv + 228, 31 pls., 10 figs., map (end papers), 1940. Oxford University Press, London, New York, Toronto. Price, \$3.50.

² Fisher, James. 'The Birds of Britain.' 8vo, 48 pp., 13 pls. (col.), 26 figs., 1942. William Collins, London.

³ Gabrielson, Ira N. 'Wildlife Refuges.' 8vo, xiii + 257, pls. 1-32, figs. 1-17, 1943. The Macmillan Company, New York. Price, \$4.00.

It has been found that simple protection may not be enough to assure the welfare of the inhabitants of a refuge but that scientific management is required. Under such management, it has been found that the refuge may prosper to such an extent that it may serve to furnish new life to the surrounding terrain or to give a stock from which may be drawn supplies to repopulate more distant areas. Added to these advantages is the glimpse that the parks preserve for present and future generations of Americans of the natural paradise that once was here.

Dr. Gabrielson, head of the U. S. Fish and Wildlife Service, is eminently qualified to write of the wildlife refuges and their problems. He has prepared a most readable and informative summary of their inception and history, with descriptions of the individual reserves, their purposes and their accomplishments. It is a heartening account and the book is a mine of information on the subject.—J. T. ZIMMER.

The Ducks, Geese, and Swans of North America.¹—This important work is one of the most useful books on North American birds that has appeared in recent years, and is destined to be of great service not only to the ornithologist but also to the sportsman. The author modestly disclaims any originality in the book which, he maintains, is taken solely from the researches and writings of others. Nevertheless, he cannot escape a great deal of credit for the assemblage of the data and the manner of their arrangement and presentation. Each species is treated in exactly the same manner so that it is very easy to find the comparable data concerning the species that it may be desirable to contrast with each other.

The pronunciation and origin of the scientific names are given, followed by a list of colloquial names and the description of the various plumages of adults and young. 'Specimen Identification' gives a résumé of the characters of special utility in distinguishing the form in question in comparison with others with which it might be confused, with special reference to a bird in hand; 'Field Marks' does the same for the bird in life, on the water or in flight, and adds a description of its voice. Under 'Life Story' is a general discussion of behavior, food, and other interesting details. A map shows the breeding and winter ranges of the form in question.

In preliminary pages are descriptions of the family and the subfamilies, illustrations showing the topography of a duck and details of the structure of the wing and leg, a glossary of special terms, a discussion of scientific nomenclature, a general discussion of molts and plumages, keys to aid in identification, methods for age and sex determination, a few longevity records, speed of flight, hybridism, and notes on duck sickness and lead poisoning. Chapters on migration (by F. C. Lincoln), banding (by Lincoln), and conservation (by Ira N. Gabrielson), are included. Weights and measurements of the various species are given in a table near the close of the book. In all, there is a wealth of general and special information throughout, surprising in that it can be compressed into the space it occupies.

In addition to the distributional maps and the series of numbered illustrations (those to which direct reference is made somewhere in the text) there are numerous other line-drawings and a great many interesting vignettes showing the different species in characteristic attitudes. A series of colored plates shows each of the

¹ Kortright, Francis H. 'The Ducks, Geese and Swans of North America. A *vade mecum* for the naturalist and sportsman.' 8vo, viii + 476, pls. 1-36 (col.), figs. 1-57 + 32b, 150 figs., 57 maps, 1942. American Wildlife Institute, Washington, D. C. Price, \$4.50 (de luxe edition, \$10.00).

species, usually the adults in winter plumage, details of wing-pattern, various hybrids, examples of eclipse plumages and molts, and the downy young of each species, all the work of T. M. Shortt. The book is to be highly recommended to all who are interested in any way in the North American members of this group of birds.—J. T. ZIMMER.

Joseph Grinnell—Naturalist.¹—Among the writers on the birds and mammals of North America, particularly those of the western coast, there has been none more versatile and stimulating than the late Joseph Grinnell. Possessed of an unusually active mind and keen powers of observation, he published voluminously on a wide variety of topics and usually approached his subject with a fresh outlook. Even his shorter articles were likely to contain some broad discussion of especial interest. To the lasting regret of his wide circle of associates and friends, he never wrote the work he had in view that would have summarized his conclusions on the subjects to which he gave a lifetime of study. Science is thereby the loser.

Perhaps he would have altered some of his earlier views—perhaps merely amplified them—for his was an open mind. Nevertheless, he left behind him published papers from which may be gleaned his developing philosophy of nature. Dr. Alden Miller, editor of the present selection from those writings, has made an excellent choice and wisely arranged the material chronologically. Twenty-eight articles are here reprinted, covering such widely divergent topics as 'Call Notes of the Bush-Tit,' 'The Role of the Accidental,' 'Barriers to Distribution as Regards Birds and Mammals,' and 'The Museum Conscience.' Those long familiar with Grinnell's writings will find old friends collected here in convenient form; those not so familiar (and there can not be many such among active American zoologists) will receive inspiration and enjoyment from the reading.—J. T. ZIMMER.

An Australian Ornithologist.²—This little brochure contains an autobiographical sketch of the author of 'Birds of Australia' and other works on the birds of the Antipodes. The latter part deals with the building up of the magnificent collection of Australian birds that came to the American Museum of Natural History with the Rothschild Collection and of the probably equally complete collection of books on the same subject that Mr. Mathews generously presented to the Australian National Library at Canberra. The present work has been prepared as an adjunct to the latter collection. Mr. Mathews's many friends will find these reminiscences interesting reading. An introduction has been supplied by Tom Iredale, private secretary to Mr. Mathews for a number of years.—J. T. ZIMMER.

Fossil Birds of California.³—The history of palaeornithology in the State of California begins in 1901 with the description by F. A. Lucas of a flightless auk, *Mancalla californiensis*, encountered in Pliocene beds during the excavation of the Third Street tunnel in the City of Los Angeles. The present work, complete to December, 1940, covers records for 157 species with notes on more than 40 in addition whose identity, except to genus or family, has not been definitely determined. The tremendous increase in our knowledge in this field covers the period

¹ Grinnell, Joseph. 'Joseph Grinnell's Philosophy of Nature. Selected Writings of a Western Naturalist.' 8vo., xv + 237, frontisp. (portr.), 7 pls. (2 col.), 1 map (fold., col.), 4 figs., 1945. University of California Press, Berkeley and Los Angeles. Price, \$2.00.

² Mathews, Gregory M. 'Birds and Books. The Story of the Mathews Ornithological Library.' Royal 8vo, 70, 7 pls., 1942. Verity Hewitt Bookshop, Canberra. Price, 10s.6d.

³ Miller, Loye, and DeMay, Ida. 'The Fossil Birds of California. An Avifauna and Bibliography with Annotations.' Univ. California Publ. Zool., vol. 47, no. 4, October 17, 1942, pp. 47-142. University of California Press, Berkeley. Price, \$1.00.

of active work to date of the senior author, and in large part is definitely representative of his individual efforts and of his precepts and influence on others. The fossil bird life of California now is better known than that of any other similar area in the world.

The introduction gives a brief description of the 30 fossil bearing horizons of the state that to date have yielded bones of birds, 6 in the Miocene, 9 in the Pliocene, and 15 in the Pleistocene. The great deposits in the last have yielded some of the finest material known, upwards of 100,000 specimens of more than 100 species having come from one locality. Bird bones have been obtained from such diverse places as marine shellbeds, diatomaceous earths, river gravels, tuff beds, oil-well borings, and above all from asphalt deposits.

The list of species gives in detail the various occurrences, with references to literature, and there is a bibliography that covers nearly four and one-half pages, followed by carefully prepared indexes. The authors have assembled a carefully written summary of the field, in synoptic form, that will serve as the basis for further studies. The data on identifications here presented are available elsewhere only through extended search in literature, and have in connection with this much interesting interpretation as to ecological conditions, ancient distribution and presumed migrations. The whole is in such useful form that we may regret the statement in the foreword that in the interest of brevity various discussions have been eliminated from the original manuscript.—ALEXANDER WETMORE, *U. S. National Museum, Washington, D. C.*

An Ornithologist in New Guinea.¹—Mr. Ripley had the good fortune of an invitation to join an expedition that set sail in early December, 1936, to cross the southern Pacific in a fifty-nine-foot schooner to northwestern New Guinea. The expedition was primarily anthropological but Mr. Ripley, as ornithologist of the party, was in search of birds for the Academy of Natural Sciences of Philadelphia and succeeded in bringing back a fine collection. His book is not entirely concerned with birds although, as may be supposed, birds find a large place in it. There are numerous descriptions of the appearance and habits of some of the fine species with which New Guinea is so generously supplied. The running account is one in which the general reader, also, who is interested in travel and the story of experiences and impressions in a strange country among strange people, will find entertaining, amusing, and informative on a variety of subjects.—J. T. ZIMMER.

A Text-book of Zoology.²—Dr. Storer has written a volume for the classroom and reference shelf that is both comprehensive and practical. The book is divided into two sections. The first deals with the general subject of zoology, discussing the fundamental structures and physiological processes of animal life (using the frog as subject), the factors of heredity and genetics, ecology, and distribution, evolution and the principles of classification and nomenclature, and the history of the science. Brief characterizations are given of the higher groups from subkingdom to class.

The second and larger part takes up the animal kingdom group by group, phylum or class, and presents the details of structure, development, and function,

¹ Ripley, Dillon. 'Trail of the Money Bird; 30,000 miles of adventure with a naturalist.' 8vo, xii + 306, 16 pls., maps (end papers), 1940. (Second edition, 1942.) Harper and Brothers, New York and London. Price, \$9.50.

² Storer, Tracey I. 'General Zoology.' 8vo, xii + 798 + 5 (unnum.), 556 figs., 1943. McGraw-Hill Book Company, Inc., New York and London. Price, \$9.75.

the natural history, distribution, activities, economic status, relations to man, fossil antecedents, and other such pertinent facts. The groups of median rank, down to orders or sometimes families, are briefly characterized on the basis, so far as possible, of the external features most easily observed. Throughout, the emphasis is on the animal as a living organism, not merely as a laboratory specimen, with the result that the student is encouraged to interpret structure in terms of function. Examples are taken, when possible, from the North American fauna.

An excellent variety of illustrations, mostly new, is provided and those relating to each chapter are separately numbered with indication of the chapter number, making reference easy. The text is clear and as simple as the subject matter permits. A short list of references is provided at the end of each chapter for the use of the student who may wish to delve more deeply. The book appears deserving of a long and useful career.—J. T. ZIMMER.

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CORRESPONDENCE

EDITOR OF 'THE AUK':—

In the review of my book, 'Cuckoo Problems,' which appeared in 'The Auk' of January, 1943, pp. 113-117, there are one or two points upon which I should be glad if you will allow me to comment.

On p. 114, paragraph one, the reviewer quotes extracts from my introduction, the general trend of which gives the impression that he considers I have accepted any eggs from any collector and have also accepted any data given as proven. If this were really the case the book would be utterly worthless and the deductions drawn and opinions expressed equally so.

As a matter of fact, however, I have exercised the greatest care in discriminating between good, bad, and indifferent evidence and my eggs, such as were not taken by myself, were taken by persons of repute who, though in many cases "amateurs," were Field Ornithologists of great ability and very wide experience, whose evidence can be accepted without any hesitation. A list of practically every one of these collectors is given on p. xii of my introduction, all of whom are, or were, well known in their own areas of work while many of them are, or were, equally well known outside them.

Next, the reviewer comments on my "Indian collectors" and says that he himself has had "ample experience" of such collectors but he does not say whether he has ever met a Khasia or Hill Tribesman. He does not refer to my remark on p. xi on the plainsman, to the effect that they cannot be relied on. I wrote, "This may be true of Plains Indians who have no interest in nature observation, but it is not correct of Hill Tribesmen whose life may depend on the proper understanding of the habits and calls of birds and animals."

Of eggs taken by Plains Indians, I have not a single one of a Cuckoo in my collection other than those of *Eudynamis* which were taken in my presence by small boys, who climbed the trees to get at the Crows' nests for me. Of Cuckoos' eggs taken by Nagas and other tribesmen, I have not a score altogether. As regards the Khasias these hill men were, as I stated, educated men, speaking English, Lepidopterists and Botanists by profession, who had been working for Hume or myself on birds and birds' eggs for many years. They were entirely reliable and, while I was in India, they actually took but few eggs, merely marking them down for me and enabling me to take eggs with my own hands, over a far wider stretch of country than would otherwise have been possible.

My paid collectors have been taxidermists and generally Englishmen who, with one exception, took very few, perhaps half a dozen, Cuckoos' eggs and no others. The exception was a man I employed in Burma and Malaya who took very few eggs—none of Cuckoos—sending them to me with the birds shot off the nest.

Finally, in this respect, I should like to say that though my collection numbers about 6,000 eggs, I must have refused or discarded nearly as many *because the data were not above question*.

I hope this may dispose of any doubts which may arise in the minds of readers as to the reliability of my material.

Next, in regard to the remarks on desertion made on p. 115 of the review. Surely the average field-worker can tell in most cases if a nest is deserted. The eggs are cold, no birds are present, no birds show agitation or resentment at the approach of human beings, while often the nest itself shows that it has been

abandoned and there are many other signs that occur to prove it. On the other hand, in many cases in which the nest may have been *very recently* deserted there is no evidence to this effect and these are not included among the proved desertions.

As regards desertions by Black-headed Shrikes, I do not quite understand the remarks made. I have gone into the facts very fully on p. 17 and again on pp. 21-22, but I lay down no law and come to no definite conclusion, merely making suggestions. I have simply tried in this instance, as in all others, to give and weigh the pros and cons and suggest a conclusion.

Again referring to my suggestion that assimilation is less obvious in Great Britain than elsewhere, he writes "Are we to believe that the Cuckoos settling in Great Britain . . . failed to bring with them the more perfectly adaptive egg they had there." Certainly not; the Cuckoos brought with them the eggs which were more perfectly adapted to their previous hosts but were utterly unadapted to their new.

The reviewer's criticism on what I write about the method by which Cuckoos deposit their eggs in birds' nests is surely not quite fair to me. I fully admitted that Chance had proved beyond all doubt that, what the older writers had often said, many Cuckoos lay in open nests just as other birds do. In domed nests neither Chance, now, nor I believe that the Cuckoo sits in the nest, for Jones and Livesey have shown that normally the eggs are projected into such nests. There are, at the same time, certain nests into which Cuckoos can obviously neither lay their eggs direct nor project them into it. There must, therefore, be a third way and the old theory that Cuckoos lay their eggs on the ground and then place them in the nest by the bill, seems a possible way and may well be the true one, but I have added that this is not proved.

The theory of "gens" of Cuckoos, parasitic on certain fosterers may, I believe, be taken as proved and because the females are promiscuous and because I have shown that each of three females of different gens in one area accepted the attentions of several males residing in that area makes it seem probable that the males do not affect the color of the eggs laid by their progeny.

No index was given, as a fairly full description of the contents is found in the Table of Contents and it was desired to save paper. Obviously, also, an index would have been a mass of duplications and would hardly have helped a reader to find what he wanted.

Fair criticism, such as that made in the review, only stimulates an author to go yet deeper into his subject or to put his views more clearly. Personally, as my only desire is to find out the truth, I welcome this criticism and hope to make use of it.

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EDITOR OF 'THE AUK':—

Mr. Manning has presented us (*Auk*, 1942, pp. 157-175) with additional and valuable additions to our knowledge of the Blue Goose, but his conclusions indicate that he is quite unfamiliar with current subspecific concepts in ornithology. Whatever the Blue Goose is, valid species or dichromatic form of the Snow Goose, it cannot be a subspecies as that taxonomic unit is at present recognized. Personally, I am inclined, at least tentatively, still to regard it as a species until there is more

definite evidence to the contrary. Its status as a dichromatism as yet is based upon little more than a "hunch," the evidence pointing almost equally in either direction. The onus of proof certainly lies with the less usual and until that is produced the only valid verdict is the famous Scotch one of "Not proven," and a more or less suspended judgment.

P. A. TAVERNER

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Ottawa, Canada

EDITOR OF 'THE AUK':—

In a recent letter from Dr. T. S. Palmer, exception is taken to the manner of use of the word 'obituary' in the latest 'Ten Year Index to The Auk'. In order to avoid confusion, an explanation may be pertinent.

Upon taking over the compilation of the index, after the death of H. S. Swarth, I found that the word 'obituary' under the name of a deceased person was being used as an adjective, not as a noun, and that citations under this caption did not necessarily refer to a formal obituary notice, but to any reference to the deceased, no matter how brief. As this appeared to me to be a reasonable use of the word, the method was not compared with that used in previous indices, but was continued throughout the remainder of the work. This, of course, resulted in the use of the caption 'obituary' under the names of numerous persons whose formal obituary notices had not yet appeared.

GEORGE WILLETT

Los Angeles Museum
Los Angeles, California

NOTES AND NEWS

Mr. N. B. Kinnear, Deputy Keeper in charge of Birds, British Museum (Natural History) Cromwell Road, London S. W. 7, has most kindly expressed a desire to be of assistance to members of the A.O.U. and other ornithologists from this country in military service who may find themselves in England. He will be glad to have them call on him at the Museum and to direct them to places of ornithological interest and put them in touch with other local bird students. Members in service are cordially invited to take advantage of this opportunity to extend their acquaintanceship with British birds and British bird lovers.

The Comstock Publishing Company advises that the prices of the records of bird songs, reviewed in "The Auk," 60: 288, April, 1943, were advanced, prior to the review, to \$1.25 for single records and \$6.00 for the set.

GENERAL COUNCIL ON ZOOLOGICAL NOMENCLATURE

The undersigned zoologists, resident in the United States of America, at the invitation of the Committee on Nomenclature of the American Society of Mammalogists and with the cooperation of the "American Commission on Scientific Nomenclature" of the Entomological Society of America, do hereby associate themselves together as a society and certify as follows:

First: The name of the society shall be the General Council on Zoological Nomenclature.

Second: The objects of the Society shall be:

(A) To act in an advisory capacity in all matters concerning zoological nomenclature during the World War and for such time thereafter as it may consider desirable.

(B) To administer, amend, interpret, and maintain a code of nomenclature for the use of zoologists.

(C) To cooperate with societies maintaining committees on nomenclature, at least those represented in its own membership.

(D) To retain within itself important powers of decision and legislation and of substitutions and additions to its membership, but always subject to full hearings and the advice and counsel of one or more of the committees above mentioned.

(E) To cooperate with zoologists practiced in nomenclature who are residents of foreign countries when the war is ended or as soon thereafter as may be practicable.

G. F. Ferris
Wilfred H. Osgood
James A. G. Rehn
George G. Simpson*
John T. Zimmer

Remington Kellogg
H. A. Pilsbry
Karl P. Schmidt
A. Wetmore

Merely on the face of it, the above may seem to be a self-constituted body of dubious possibilities and audacious construction. That this is not the case may be evident when its history and purposes are explained. It is the outgrowth of

*Dr. Simpson's signature is assumed on the basis of his verbal agreement before he left for war service where he cannot now be reached.

numerous informal discussions among a large number of zoologists during the past few years and of formal action taken by at least two national societies.

Even in years just prior to the war, the International Commission on Zoological Nomenclature was relatively inactive and after hostilities began in Europe in 1939 it became practically non-functional. This created a situation in which all cooperative action was endangered and nearly a century's hard earned progress was threatened. Individuals and organizations began to discuss special codes for themselves only and in some cases took definite action. Recently a German (Poche) has promulgated a code of his own and in general every zoologist having a nomenclatural problem finds himself without appeal to any constituted authority. It was precisely to avoid this condition that codes and commissions were devised.

Discussion among zoologists unanimously recognized the emergency, but it was difficult to arrive at a basis for action which did not involve very great delay and long-drawn controversy. There were those who felt that the international idea could not be abandoned and others who advocated complete divorce from the Old World. The latter pointed to the success of the International Commission as being mainly due to the American, C. W. Stiles, whose final conclusion (see 'Science,' 73, pp. 349-354, 1931) was that it was not further workable. Among those holding this opinion were several Europeans.

As announced in 'Science' (June 12, 1942) the Entomological Society of America, pursuant to action taken at its meeting in December, 1941, formed an "American Commission on Scientific Nomenclature in Entomology" apparently with the object of proceeding independently. Somewhat later, at its annual meeting in April, 1942, the American Society of Mammalogists instructed its standing committee on nomenclature "to act pro-tem in the present world crisis for the Committee [sic] on Nomenclature of the International Commission." The Mammalogists' committee felt that any committee restricted to a particular branch of zoology would be ineffective. Therefore, with the approval of the Society's president and principal directors, this committee entered into correspondence with the entomologists proposing that the two committees, without further authorization, jointly sponsor the selection of a small group of representative nomenclaturists to "take over," at least for the time being. Full cooperation between the two committees proved impractical without great loss of time, so the Mammalogists' committee, after receiving the approval of the majority of the entomologists, selected and organized the group as indicated above. The membership of the Mammalogists' committee which carried this out was as follows: A. Cabrera, E. R. Hall, G. S. Miller, Jr., W. H. Osgood, T. S. Palmer, G. G. Simpson, and G. H. Tate.

The "Council" thus formed is frankly experimental and the method of its genesis is unusual, but those responsible for it have felt that any other method, especially in these times when large general meetings are interdicted, would defeat itself in prolonged discussion and fatal delay. Under restrictions which the Council has placed upon itself it is hoped that it may be a wholly representative and co-operative body. A brief set of by-laws has been adopted in which important provisions are to the effect (1) that the active membership shall not exceed fifteen, (2) that additions and replacements shall be made only from candidates nominated by large associations of zoologists, and (3) that no important action can be taken without first obtaining the opinion of at least two nomenclatural committees of national societies and several individuals not members of the Council. A judicial function is thus implied preceding any legislation.

It does not propose to supersede any existing special nomenclatural committees, but on the contrary it is designed to stimulate them to greater interest and more action. Its post-war status is problematical, but at least as a temporary measure and an effort in a direction urgently needing attention, it is hoped it may find support. At an early date it is proposed to increase the membership from nine to eleven in order to cover important branches of zoology which are not now well represented.

The by-laws giving details of proposed action will soon be available for distribution to any interested zoologists who may apply for them.

WILFRED H. OSGOOD
Secretary

THE ANNUAL MEETING

At the time of going to press, it is not possible to give any definite information concerning the Sixty-first Stated Meeting of the A. O. U., planned, tentatively, for assembly in New York City some time this year. In view of the precedent already set by the Government, as a war-time measure, it seems unlikely that a full session can be contemplated, with presentation of papers and social events, although a formal business meeting of officers of the Union probably will be attempted. In the event that a more elaborate program is found to be possible, later advice may be given out by the Secretary.

ROBERT CUSHMAN MURPHY,
Chairman of the Committee on Arrangements

OBITUARIES

HUBERT LYNES, Rear Admiral, R.N., and an Honorary Fellow of the American Ornithologists' Union, died at a naval hospital in England, November 10, 1942, at the age of nearly 68. He was born November 27, 1874, and entered the Navy when 13 years old. Here he began a distinguished career which included thirty-two years in the service. From 1905 to 1908 he was in command of H.M.S. 'Venus' on the Mediterranean station and from 1910 to 1912 of H.M.S. 'Cadmus' on the China station. During the First World War he commanded H.M.S. 'Penelope,' 1914-1917, was in command of the Allied Naval and Marine forces, 1917-1918, commanded the Ostend forces under Admiral Keyes in blocking the canal at Zeebrugge in April, 1918, commanded H.M.S. 'Warspite,' 1918, and was present at the surrender of the High Seas Fleet, November 21, 1918. For his services he was awarded the Croix de Guerre, and was made Commander of the Legion of Honor and of the Order of Leopold in 1918. The following year he retired at his own request and was promoted to Rear Admiral, retiring in 1922.

Lynes's interest in birds and especially birds' nests developed at an early age and he never lost his interest in birds' eggs. In 1910 he accompanied Abel Chapman and Walter Buck to the Andalusian Sierras in Spain. He made twelve expeditions to Africa, covering most parts of the continent, and it was said that he probably knew more about the birds of Africa in the field than any of his contemporaries.

While working up the results of the Dafur Expedition of 1920-1922, he became interested in the Fantailed Warblers of the genus *Cisticola*. This study appeared as a special volume of 'The Ibis' in 1930 under the title 'Review of the Genus *Cisticola*' and brought him the award of the Godman-Salvin gold medal of the British Ornithologists' Union. After the publication of this volume he made four more expeditions to Africa to clear up various points for an Appendix on which he was working at the time of his death. On his last expedition in 1938, he contracted shingles which affected the sight of one eye and he arrived home in 1939 in poor health. On the outbreak of the present war he was appointed Royal Naval Officer in north Wales.

While on the Mediterranean station he made many interesting observations on the birds of the region, particularly on migration, at Malta, Crete, and Port Said, which were published in 'British Birds.' Later, with F. C. Jourdain, in 1936, he renewed his acquaintance with Egyptian birds. He was elected a member of the British Ornithologists' Union in 1904 and served as Vice President in 1929. He was elected a Corresponding Fellow of the A.O.U. in 1930 and advanced to Honorary Fellow in 1941. He contributed frequently to 'The Ibis' and 'British Birds.' Most of his field notes and particularly his notes on the birds collected in China, together with his 'bird log' containing notes, sketches, and maps, were lost during the First World War when his cabin on the 'Penelope' was blown up by a torpedo from a submarine.

Admiral Lynes never married and when not on sea duty was under the watchful care of his devoted sister, Miss Lynes. He was described as an "outstanding character who had ideas of his own and carried them through, devoted to duty, a man of great generosity and the best of companions. He was handicapped by gun deafness but this was offset by an extremely quick eye. He was often impetuous but prepared for action or an expedition in a most methodical way." A more extended account of his activities, by H. F. Witherby, from which this

sketch is condensed, may be found in 'British Birds' for January, 1943, pp. 156-158.
—T. S. PALMER.

HUGH McCORMICK SMITH, an Honorary Life Associate of the American Ornithologists' Union, elected in 1886, died in Washington, D. C., Sept. 28, 1941, in his 76th year. He was the son of Thomas Croggon and Cornelia Frances (Hazard) Smith and was born in Washington, Nov. 21, 1865. His education was acquired in the public and high schools of the Capital and the Medical School of Georgetown University, from which he received the degree of M.D. in 1888. After graduation he did some postgraduate medical work in New York and later was awarded the degree of LL.D. by Dickinson College in 1908.

His life work in fisheries began in 1886 with his appointment by Prof. S. F. Baird as assistant in the U. S. Fish Commission. Here his promotion was steady from the lowest to the highest grades. He held successively the positions of Assistant in charge of the Division of Fisheries, 1892-1897, Assistant in charge of Scientific Inquiry, 1897-1903, Director of the Biological Laboratory at Woods Hole, Mass., 1901-1902, Special Agent in charge of Fisheries in the 10th Census, and when the Fish Commission was made a bureau of the Department of Commerce, Deputy Commissioner, 1903-1913, and Commissioner of Fisheries, 1913-1922. During this time he traveled extensively and visited 22 foreign countries, represented the United States at various International Fisheries Congresses and served as Secretary General of the International Fisheries Congress of 1908. After his retirement as Commissioner of Fisheries, he visited Uruguay to investigate the fur seal rookeries on the Lobos Islands. In 1923 he became adviser in Fisheries to the Siamese Government and in 1926 Director of the Department of Fisheries of Siam. His work in fisheries was recognized abroad by the award of seven medals, including two from the Government of Siam.

During his student days, Smith was active in collecting birds with William Palmer and C. W. Richmond in the vicinity of Washington and obtained the data for the series of notes published in 'The Auk' from 1885 to 1902. Later, during a residence of twelve years, between 1923 and 1934, in Siam, he collected a series of nearly 6500 birds which formed, in part, the basis of J. H. Riley's comprehensive report on 'The Birds from Siam and the Malay Peninsula, in the U. S. National Museum collected by Dr. Hugh M. Smith and William L. Abbott,' 1938. One of his principal contributions to Ichthyology was a volume on 'The Fishes of North Carolina' published by the state Geological and Economic Survey in 1907.

Dr. Smith took an active part in scientific work and was a member of a number of organizations. He was a Fellow of the American Association for the Advancement of Science, a member of the American Society of Naturalists, American Fisheries Society (president, 1907-1908), National Geographic Society, Biological Society of Washington (president, 1919), Washington Academy of Sciences and the Medical Society of the District of Columbia. He is survived by his widow and two daughters, Mrs. Carl H. Clanky, Jr., of Washington, and Mrs. E. V. Cowdry of St. Louis, Missouri.—T. S. PALMER.

LUCY HUNTER BAIRD, an Associate of the American Ornithologists' Union for nearly 14 years, died in Philadelphia, Pa., June 19, 1913, at the age of 65. Thirty years have passed since her death but no account of her activities has thus far appeared in 'The Auk.' She was born in Carlisle, Pa., Feb. 8, 1848, the only child of Spencer Fullerton and Mary Helen Churchill Baird. Her father in later years

was Secretary of the Smithsonian Institution and her grandfather on her mother's side was Quartermaster General of the Army. During the greater part of her life she lived in Washington, but in later years, after the death of her parents, she resided in Philadelphia.

In the last decade of her father's life she assisted him in a secretarial capacity in connection with his work in the Smithsonian Institution and the U. S. Fish Commission. When only 13 years of age she had the distinction of having a bird, now known as *Vermivora luciae*, named in her honor. This lovely little warbler, characteristic of Arizona, New Mexico, and the valley of the Colorado River in California, was discovered by Dr. J. G. Cooper, near Fort Mojave on the Colorado River, and described by him. In this connection it is interesting to recall that Dr. Cooper, while in Washington preparing for his field work, was a member of the 'Megatherium Club,' a Smithsonian dining club over which Lucy Baird exercised a motherly supervision.

At the first Philadelphia meeting of the A.O.U., in 1899, Miss Baird was elected an Associate of the Union. Her chief contribution to ornithology was her collection of material for a life of her father. For years it was her ambition to prepare his biography, and for this purpose she assembled a wealth of letters, notes, reminiscences, photographs, and other memorabilia, but failing health prevented her from completing this project. At her death she bequeathed the collection to her executor with instructions to have it worked up by a competent biographer. The task was entrusted to her father's friend and associate, Dr. W. H. Dall, who in 1915, two years after her death, published a comprehensive work entitled 'Spencer Fullerton Baird, a Biography.' The volume of 462 pages was dedicated "to the memory of a devoted daughter, Lucy Hunter Baird," and included a reproduction of her portrait opposite p. 416. Miss Baird is interred with her parents in Washington, D. C., in the Churchill vault in Oak Hill Cemetery.—T.S. PALMER.

SARAH LUCY (COLLIER) BLOOMFIELD (MRS. CHARLES CUNNINGHAM BLOOMFIELD), an Associate of the American Ornithologists' Union, elected in 1901, died at her home in Jackson, Mich., Feb. 18, 1941, as the result of a stroke of apoplexy which she had suffered ten days earlier. At the time of her death, Mrs. Bloomfield was the oldest American member of the Union, having attained the advanced age of ninety and one-half years. She was born Aug. 9, 1850, on a farm eleven miles west of Jackson, about midway between Concord and Parma, Mich., and at the age of fourteen went to Jackson to attend school. Four years later, in 1868, she graduated from the Normal College in Ypsilanti after specializing in music.

In 1870 she married Charles Cunningham Bloomfield, a prominent business man of Jackson, who died in 1923. Twenty years after her marriage she was elected a member of the Jackson School Board and in 1893 became president of the Board. It was said that she was then the first woman in the country to become head of a school board. Mrs. Bloomfield was active in social and cultural affairs almost up to the time of her death. In later years as her sight began to fail she allowed her membership in the Union to lapse but at the Boston meeting, in 1940, she was reelected as an Associate only four months prior to her death. She is survived by two sons, Arthur C. and Leigh C. Bloomfield, and three grandsons.—T. S. PALMER.

GEORGE JOHN CLOUT, an Associate of the American Ornithologists' Union, died on May 11, 1941, in St. Catharines, Ontario, the Canadian city in which he had made his home ever since the end of the last great war. He was born in the

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village of Pembury, near Tunbridge Wells, in the county of Kent, England, on May 5, 1885, and came to Canada when a young man. In England, he would appear to have had just a normal country boy's interest in the local bird life around his home, and it was not until he had been in Canada for a number of years that his latent love of nature found expression in more serious field studies of the very different and much more varied avifauna of his adopted homeland.

George Clout was very interested in boys' work; on many occasions he gave lectures on birds to school children, and was an enthusiastic leader among local Scouts and Rovers. It was this work among boys of eager and inquiring mind that helped so much to foster and increase his own knowledge of birds in the field, and shortly before his untimely death at the age of only 56, he had acquired a reputation as one of the most active nest-finders in southern Ontario, a circumstance which is amply evidenced by the repeated references to his Lincoln County nesting records in 'The Distribution of Breeding Birds in Ontario' by J. L. Baillie, Jr., and Paul Harrington (Trans. Roy. Can. Inst., Vol. 21, parts 1 and 2, 1936 and 1937).

Beyond an occasional letter, or short article, on bird-life appearing in the local St. Catharines newspapers, Clout did not publish anything; but he did generously contribute some excellent notes and observations, in addition to those mentioned above, to several articles published by others, in particular to 'A Preliminary List of the Birds of Lincoln and Welland Counties, Ontario' by Sheppard, Hurlburt, and Dickson (Can. Field-Nat., Sept.-Dec., 1936), and to an addendum to that list by Sheppard (Can. Field-Nat., March, 1939).

In addition to being an Associate of the Union, Clout was a member of the Wilson Club and a subscriber to the 'Canadian Field-Naturalist,' as well as an active member, and one time District Chairman, of the Federation of Ontario Naturalists. Many of George Clout's notes and records, especially on the breeding birds of the St. Catharines area, are preserved in the files of the Royal Ontario Museum of Zoology in Toronto, while a fairly complete set of his general records covering four years, 1936 to 1939 inclusive, are filed in the writer's private library at Niagara Falls. His fine philosophy of life in general, his almost boyish enthusiasms, and constant thirst for additional knowledge of the local bird-life, as well as his ever-generous nature in sharing his findings with others, will long be remembered by all who enjoyed his friendship or had the privilege of talking with him upon his favorite subject of Natural History.—R. W. SHEPPARD, *Niagara Falls, Ontario*.

FRED LEROY HOMER, an Associate of The American Ornithologists' Union, was the son of Jacob and Sarah Homer, born October 13, 1870, in Delaware Township, Mercer County, Pennsylvania, near the village of New Hamburg, and died September 26, 1930, in Pittsburgh. He was, inferentially, a descendant of that Jacob Hommer, a native of Germany, who in 1809 settled in West Salem Township, Mercer County, upon a tract of land that lies partly within the limits of the present borough of Greenville. He was graduated from Allegheny College, Meadville, Pennsylvania, with the class of 1895 and with the degree of A.B. Subsequently he received a master's degree in English from Harvard.

He became a teacher, and in 1909 he came from Warren, Pennsylvania, to McKeesport. Two years later he went to the Central High School, Pittsburgh, and thence in 1916 to the newly completed Schenley High School, Pittsburgh. There

he continued to the end of his life. His subject was English Literature. He made effective many departmental improvements in the school system of the city; and he promoted in his own school extra-curricular activity.

Mr. Homer never married. He was a member of the Methodist Episcopal Church. In 1928 he became a trustee of Allegheny College. In 1924 he became an Associate of the American Ornithologists' Union, and he continued in the associate membership through the remaining six years of his life.

His chief interests were in English literature and in natural history. He published an annotated edition of Milton's poems; and, in 1923, a small pamphlet for use by school children, entitled 'Some Common Birds and Wild Flowers.' He furnished for the preparation of Todd's 'Birds of Western Pennsylvania' a list of the birds of New Hamburg. His notebooks and journals are in the Carnegie Museum, Pittsburgh.—BAYARD H. CHRISTY.

WILLIAM JAMES RUSLING, an Associate of the American Ornithologists' Union, elected in 1941, was killed in an automobile accident in Piscataway Township, near New Brunswick, New Jersey, August 16, 1942. At the time of his death he was on his way to the northern part of New Jersey for a field trip. He was the son of Frederick E. and the late Charlotte (Taylor) Rusling and was born in West Caldwell, New Jersey, May 12, 1912. He attended Montclair (N. J.) Academy and Hobart College. At the time of his death he was employed by the Atlantic Diesel Corporation, New Brunswick.

Rusling's main interest was ornithology, especially hawks and owls, but he was well versed in the entire field of vertebrate zoology, as well as botany. During the fall of 1935 he was Audubon Warden at the Witmer Stone Wildlife Sanctuary, Cape May, New Jersey, and the following fall was sent to the southern part of Cape Charles, Virginia, to study the hawk migration. A great deal of his time was spent studying the ridge flight of hawks in New Jersey. At the time of his death he had just finished a three-year-study of the feeding habits of owls.

Beside holding membership in the Union, Rusling was a charter member of the Urner Ornithological Club, of which he had been president (1940-41), and a member of the Montclair Bird Club, the New Jersey Field Ornithologists' Society, and Theta Delta Chi.—WILLIAM F. RAPP, JR.

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